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THE  
**CHEMICAL NEWS**

AND  
JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

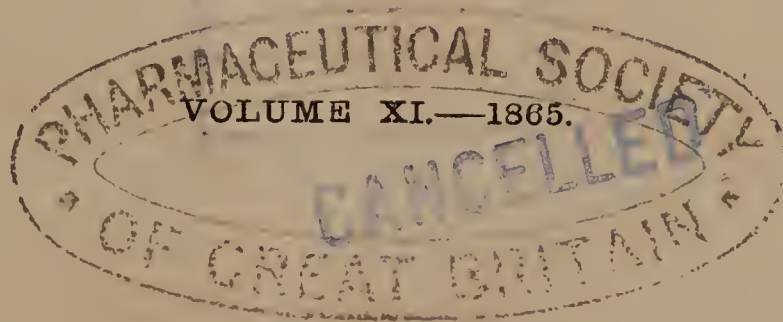
*A Journal of Practical Chemistry*

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.



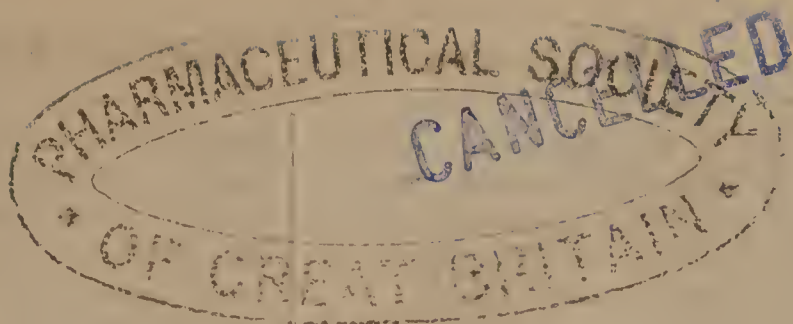
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# THE CHEMICAL NEWS

VOLUME XI.

No. 266. January 7, 1865.

## THE ALKALI WORKS REGULATION ACT.

THE Alkali Works Regulation Act has now been in force twelve months. We say in force; but it is, we believe, a fact that the machinery for setting it in practical operation was not completed until some months after the Act legally took effect. There has been time enough, however, to draw some conclusions as to the practical results of the operation of the Act. Our readers will remember that the object of the Legislature was to compel manufacturers to condense at least 95 per cent. of the hydrochloric acid evolved in the production of soda from common salt. An opinion seems to be prevalent that the object was to prohibit the escape of noxious vapours from all chemical works; but, in fact, no such general enactment exists. The operation of the present Act is strictly confined to alkali works. Sulphurous fumes from copper works are allowed to escape as before; and the most careless management of chemical works still remains without Government interference. In a late action against a copper work in Lancashire, it was argued that the Act applied universally; but in the face of the precise words of the Act, it is needless to say the argument broke down. We have only, then, to see what has been the effect of the law, so far as regards alkali works. Now, it is a curious fact that in the course of our inquiries we have found that it is precisely in places, like St. Helens, most complained of (for an account of its condition see CHEMICAL NEWS, vol. vi., p. 202) that the Act has been most thoroughly effective. Indeed, we were informed that it has been so to an extent never dreamt of by the Legislature. It will be remembered that in their evidence before Lord Derby's Commission some of the principal members of the alkali trade insisted that perfect condensation was impossible; and that at least 5 per cent. of the acid must be allowed to escape. Lord Derby yielded to this representation, and 95 per cent. was the amount fixed upon to be condensed. Upon trial, however, it would seem that perfect condensation is by no means an impossibility. It is found, for example, that a cubic foot of the escaping gases from some manufactories may be passed through a solution of nitrate of silver without affording the least trace of a precipitate, whilst in one case the merest trace was found after the gas has passed through the solution without interruption for three days and nights. This carefulness, we are happy to learn, is spreading rapidly through the trade, and it is found that the manufacturers are not at all satisfied with keeping within the Act. They perceive, in fact, what was evident enough, that if 95 per cent. of the acid

could be condensed, there could be no difficulty in condensing the whole, and they are doing their best to effect this, and so remove every possible cause of complaint. Nothing less was to be expected from gentlemen who gave evidence before Lord Derby's Commission, sometimes against themselves, with a fairness and straightforwardness which could not be too highly praised.

We have said that there is no difficulty in the way of complete condensation, nor is there when close furnaces are used. With open furnaces, however, it would seem that there must be some escape, but in the best of these the escape does not much exceed 1 per cent. At St. Helens we understand there are no open furnaces, so that this town has been so far favoured. And yet the wilderness around that town is not likely soon to blossom as the rose. It is still what it was described by a witness before the Commission, "one scene of desolation. You may look round for a mile, and not see a tree with any foliage on whatever." The fact is, that only one "noxious vapour" has been suppressed. Others no less deadly, but almost as easily prevented, are still allowed to escape as freely as before, and while these are at large the country round St. Helens can never be like what it was fifty years ago. We have made these last remarks chiefly to call attention to the fact that the Alkali Act has a very narrow territory, and no influence beyond it. But the satisfactory results of its operation will no doubt encourage the Legislature to proceed further in the same direction; and much as we deprecate, in a general way, Government interference with private enterprise, we are bound to express our belief that an extension of this enactment may be productive of much good.

## DR. HOFMANN'S EXHIBITION REPORT.

A FEW weeks ago the newspapers reported the destruction of the last remaining portion of Captain Fowke's palace. Probably the last load of bricks and rubbish has now been carted away from the site, and the building is as much a matter of history as the Exhibition itself. The building may be forgotten as soon as possible, and much respecting the Exhibition it would be well to forget. But there is one thing we have no wish to forget—and if we had the wish our correspondents would not allow us to indulge it—and that is the Jury Report on Class II., Section A. Ever since we first announced the issue of this Report, and described the valuable nature of its contents, we have been continually receiving applications for information how to obtain it. The publication was, indeed, long delayed, but when the



Report was perused the delay was forgiven. All the other Reports might easily have been written *currente calamo*, but even one of the greatest masters of chemical science could hardly collect and put together the information here detailed without much tedious labour.

The Exhibition Commissioners seem to have seen at once the value of the Report. All the others had been sold separately as they appeared, but this they seem to have reserved to secure the sale of the bulky and (but for this Report) almost worthless volume which contained the others.

It seems to have had the effect desired, for we have recently learned from Mr. Le Neve Foster that the Society of Arts (to which body the Reports were made over) "have no separate copies, and there are no bound copies for sale. It is out of print." The demand for Dr. Hofmann's report, however, still continues, and, considering the nature of the work, is likely to continue. Now, we do not know whether the Exhibition Commission is yet in existence, or whether it has wound up the affair and dissolved itself; but if it still exists we would once more urge the re-issue of this Report in a separate form. The publication would in all probability be profitable; but if it resulted in a loss, it would be a far better expenditure of the profits of the Exhibition than anything done with the money made in 1851. But supposing the Commission extinct, we feel confident that the scientific materials of the Report could easily be rearranged for a separate publication. At the present time there is no work on technical chemistry in the English language which contains so much useful information for manufacturing chemists, and a very small amount of labour would convert it into a book which would take a permanent place in our scientific literature.

We throw out the suggestion that an enterprising publisher would probably find it profitable to undertake this work, and we have reason to know that Dr. Hofmann would willingly lend his hand in making the requisite alterations and additions.

### SCIENTIFIC AND ANALYTICAL CHEMISTRY.

#### *Chemical Examination of an Ancient Metal Statue of Buddha from Hindostan, by DAVID FORBES, F.R.S., &c.*

THIS statue was lately found by Messrs. Turnbull and Harris in the remains of a large temple discovered at Sooltange, on the Ganges, in excavating the ground for a station-yard on the Great East India Railway. The temple would appear to have been of remote antiquity, as on the mound of *débris* covering its extensive ruins the remains of another Buddhist temple are seen, built subsequently, and probably without any knowledge of the more ancient and far more extensive remains buried below it, and in which this statue was discovered.

The liberality of Mr. Samuel Thornton has rescued this interesting work of art from destruction, and by him it has lately been presented to the town of Birmingham.

The statue measures 7 feet 6 inches in height, and weighs about a ton. With the exception of the left foot, which is wanting, it is in a very perfect state of preservation. It is supposed to belong to the earliest period of the Buddhist faith, and consequently would probably be about 2500 years old.

It has been cast upon a core, which in the case of the arms has been strengthened by the introduction of a

small bar of iron of about half an inch square. After casting, it appears to have been chiselled to the fine surface which it must have presented before the oxidation due to its long interment.

As the metallic alloy of which it is composed was one very unfavourable to anything like good casting, the numerous flaws which occur in it have been very cleverly concealed by pieces fitted in from outside.

When a fresh surface of the metal was disclosed by filing, it was found to present a dark copper colour, and the specific gravity was found to be 8.29 at 60° Fahr.

The analysis showed no traces whatever of tin, zinc, lead, antimony, or bismuth, and the percentage composition was found to be as follows:—

Copper	.	.	.	.	.	91.502
Iron	.	.	.	.	.	7.591
Silver	.	.	.	.	.	0.021
Gold	.	.	.	.	.	0.005
Nickel and manganese	.	.	.	.	.	traces
Arsenic	.	.	.	.	.	0.079
Sulphur	.	.	.	.	.	0.510
Insoluble slag	.	.	.	.	.	0.292
						100.000

From this analysis it would appear that the statue had been cast directly from crude or unrefined copper, and the absence of any intentional alloy would at first glance indicate a very early period of art. On the other hand, however, the iron stays used in the core of the statue and several iron work-tools (adzes, axes, &c.), found in an extremely oxidised condition along with the statue, would show that this latter metal, although so frequently hitherto regarded as evidence of a later civilisation, was one with which the founders of this statue were well acquainted.

Copper by itself giving but extremely imperfect and unsound castings, the use of alloy seems to have been one of the first advances made in practical metallurgy, and examinations of ancient metallic remains from the most distant parts of the world, whether amongst the Celts, Egyptians, South Americans, or others, shows that their experience has resulted in employing nearly the same proportions of copper and tin in the alloys that they made use of in the different countries.

#### *The Dissociation of Carbonic Oxide, by M. H. SAINTE CLAIRE DEVILLE.*

I HAVE elsewhere described the curious phenomena of decomposition which take place with bodies submitted to the action of heat. Water and carbonic acid, which at the moment of their formation develop such great heat, possess the apparently paradoxical property of partially resolving themselves into their elements, when heated to a much lower point than that of their complete decomposition or the combination of the simple bodies of which they are constituted. I compared the phenomena of combination or complete decomposition with those of boiling or the condensation of vapours.

On certain compound bodies, such as water and carbonic acid, the gaseous elements of which have the property of recombining after having been separated at a high temperature, I employed a particular system of experimenting, which I have already described in various memoirs on this subject. For oxide of carbon, which is reduced to carbon and oxygen, that is to say decomposed into a solid and a gaseous matter, another kind of apparatus is required, its description being the object of this memoir.



The electric spark decomposes a great many bodies, and in all probability it acts upon them only by reason of the enormous heat it develops; it, therefore, seemed to me that if this decomposition was not always followed by a new combination of the separated elements, it might be caused by these elements being immediately placed in contact with an atmosphere in movement and relatively very cold. In fact, the mass or the number of molecules of greatly heated gas at the moment of the discharge is very small, on account of the smallness of the quantity of fire with respect to the surrounding gaseous mass, whose temperature scarcely varies; all these conditions are realised without electricity in the following manner:—Place in a furnace, the temperature of which can be raised to a very high point, a porcelain tube fitted with corks each pierced with two holes; into one of these holes at each end pass small glass tubes, one to carry gas into the porcelain tube, and the other to conduct it from the apparatus. The remaining holes admit a small brass tube eight mm. in diameter, which passes the whole length of the tube, and through which flows constantly a rapid current of cold water. Finally, two small screens of polished porcelain separate in the interior of the porcelain tube the part which should be heated and that which, on coming from the furnace, should be almost cold.

The apparatus being thus arranged, direct into the porcelain tube a current of pure, dry oxide of carbon, proceeding from apparatus giving out regularly from 4 to 6 litres an hour.\* Pass the gas issuing from the porcelain tube into one of Liebig's potash bulbs or into baryta water, by means of which the presence and the quantity of carbonic acid are shown. The carbonic acid becomes apparent as soon as the porcelain tube is heated to redness. The oxide of carbon is then decomposed into oxygen, of which a part, if not the whole, has been employed to produce the carbonic acid, and into carbon, which attaches itself in the form of lamp black to the brass tube traversing the porcelain tube through and through. This brass tube, even at the warmest parts, is kept at about  $10^{\circ}$  by the continuous current of water. The mass of water is great enough to remain unheated while traversing the incandescent tube.

We have thus, in a very small space, a greatly heated cylindrical porcelain surface, and a very cold, concentric brass surface. The molecules of oxide of carbon heated in the lower parts of the porcelain tube rise rapidly, after having been partially decomposed into oxygen and carbon, but, encountering the cold and rugged side of the brass tube, the particles of carbon mechanically attach themselves to it. From this moment, cooled as they are by the water circulating in the metal tube, they nevertheless escape the action of the oxygen or the carbonic acid which this oxygen may form at the expense of the excess of oxide of carbon. The brass tube is, in fact, found to be blackened by the carbon when the apparatus is carefully taken to pieces, and its quantity is in proportion to the quantity of carbonic acid fixed in the bulbs connected after the porcelain tube.

\* Oxide of carbon is prepared with dry oxalic acid and concentrated sulphuric acid. The gaseous mixture traverses several flasks containing solution of potash and several U-shaped tubes containing fragments of caustic potash. The oxide of carbon then passes into an iron tube filled with fine iron wires, and heated to redness. To free it from the carbonic acid produced under the influence of the iron, it is again passed through potash bulbs and over fragments of potash contained in a U-shaped tube. By operating in this way I am certain to exclude all traces of air or of carburetted gases. The flask containing the oxalic acid is heated by a gas apparatus giving a constant heat, regulated by means of a very delicate tap.

If I correctly understand this phenomenon, carbon should be found only on the lower parts of the brass tube, which alone receive the gaseous molecules at the moment when they are removed by heating from contact with the lower part of the porcelain tube. I have invariably found this to be the case in numerous experiments I have made with this kind of apparatus.

It will be seen that the method of experimenting I have just described is capable of great extension and numerous applications.

First, by making a very small slit in the brass tube at the spot where the gas coming in contact with it is hottest, and by making the water flow through a sufficiently long vertical tube, a kind of aspirator is obtained, by means of which the hottest gases can be exhausted, rapidly cooled by contact with water, and collected in an *eprouvette*, which will separate them from the flowing water. An apparatus of this kind, or modified according to circumstances, allows the gases to be drawn from a furnace, and the development and combustion of long flames to be studied.—*Comptes Rendus*, lix., 873. 64.

### Notes on the Platinum Metals, by M. CAREY LEA.

#### PART II.\*

(Continued from Vol. x., page 301.)

**Reactions of Hyposulphite of Soda.**—In the first part of this paper I described the reaction of sesquichloride of ruthenium with hyposulphite of soda, a substance which will probably be found to be the best touchstone which we have for detecting its presence. I shall now briefly describe the behaviour of that reagent toward other metals of the group, and then proceed to examine how its behaviour toward ruthenium is modified when one or more other metals are present in the same solution. The remarkable properties which the platinum metals possess of exhibiting in many cases reactions, when mixed, wholly different from those which they show separately, renders this a point of much importance.

The hyposulphite is to have a little ammonia added before using as already mentioned. The ammonia must be in sufficient quantity to ensure that the solution after the addition of the solution of the platinum metal shall be alkaline.

**Bichloride of Ruthenium and Ammonium** gives, with hyposulphite of soda mixed with ammonia and boiled, a rich sherry wine colour. This differs materially from the reaction of ammonia alone, which produces a pale straw colour; in both cases a very dilute solution is supposed to be used.

**Sesquichloride of Ruthenium.**—As already described, a rich red purple by boiling; when dilute, nearly a rose colour.

**Bichloride of Iridium and Ammonium** is simply decolorised.

**Sesquichloride of Rhodium.**—Straw colour or yellow, according to strength of solution.

**Bichloride of Platinum.**—The addition of hyposulphite of soda mixed with ammonia produces at first a precipitation of platinum sal ammoniac, which by heat (if the solution be not too strong) is re-dissolved to a yellow liquid. Boiling renders this at first paler, and almost colourless; the reaction then changes, and the colour deepens to a rich wine brown.

**Protochloride of Palladium.**—To apply the test to this metal, place a solution of hyposulphite in a test-tube with a little liquid ammonia, and add a drop of

\* *Am. Journ. Science and Arts*, No. 113, Vol. xxxviii.



palladium solution, so that it shall communicate a pale lemon colour only to the liquid. By boiling this rapidly darkens to a wine brown shade, increasing in intensity until it finally appears black. Dilution, however, shows that this results from its intensity only; the diluted liquid is clear from troubling, and has a warm brown tint.

**Detection of Ruthenium in Presence of Iridium by Hyposulphite of Soda and other Reagents.**—For the following examinations, solutions of sesquichloride of ruthenium and of chloriridiate of ammonium were used. Both in a state of perfect purity were weighed dry, dissolved, and mixed in the following proportions:—

$\text{Ru}_2\text{Cl}_3$ , 1 part; chloriridiate of ammonium, 10 parts.

The hyposulphite test was not in any way impaired by the presence of iridium.

Sulphocyanide test gave a red colouration, but much less clear than in the absence of iridium,† and much inferior to the reaction with hyposulphite.

Acetate of lead added and boiled gave a precipitate in which the purplish shade characteristic of ruthenium was very evident.

$\text{Ru}_2\text{Cl}_3$ , 1 part; chloriridiate, 20 parts.

Hyposulphite gave a perfect reaction.

Sulphocyanide, reddish brown colouration and unsatisfactory.

Acetate of lead gives a precipitate still distinctly coloured by ruthenium. It is to be regretted that to judge correctly of this test it is necessary either to be very familiar with the colour of the precipitate which the lead salt produces with a ruthenium solution, or else to prepare it for comparison.

$\text{Ru}_2\text{Cl}_3$ , 1 part; chloriridiate, 50 parts.

Hyposulphite gave a perfect reaction.

Sulphocyanide having failed in a solution containing a larger quantity of ruthenium, was not here again tried.

Acetate of lead gave a precipitate which, when carefully compared with that afforded by a perfectly pure iridium solution, exhibited a shade of difference, but scarcely sufficient to afford any criterion; at least, this must be regarded as the extreme limit of the sensibility of mixtures of Ru and Ir to this reagent.

$\text{Ru}_2\text{Cl}_3$ , 1 part; chloriridiate, 100 parts.

Hyposulphite, perfect ruthenium reaction.

$\text{Ru}_2\text{Cl}_3$ , 1 part; chloriridiate, 200.

Hyposulphite, satisfactory ruthenium reaction.

$\text{Ru}_2\text{Cl}_3$ , 1 part; chloriridiate, 500.

Even in the presence of such an enormous excess of iridium salt, ruthenium is capable of being detected by a practised eye by means of the hyposulphite test, although the clear rose colour produced in the previous trials was here changed to an orange shade.

It may, therefore, be concluded that for the detection of ruthenium in the presence of iridium, the hyposulphite test is at least ten times more delicate than acetate of lead, and even much more so in comparison with sulphocyanide of potassium.

Dr. Gibbs has proposed a test for ruthenium by the use of alkaline nitrite and sulphide of ammonium. It was my wish to compare this method with that which I here describe, but I did not succeed in obtaining the reactions of which he speaks, although I tried both nitrite of potash prepared by passing the red fumes evolved by

the reduction of nitric acid through a potash solution, and also with nitrite of soda prepared from the nitrate.

In the first part of this paper I recommended that when solutions containing very little ruthenium were to be tested, they should first be boiled with a little pure chlorhydric acid. This is an important point, the neglect of which may cause the presence of ruthenium to be overlooked when it exists in sufficiently large quantity to be recognisable, even by the ordinary tests, after this precaution has been taken.

After making the foregoing experiments, I had occasion, after an interval of some hours, to repeat them on the same diluted and mixed solutions which had been preserved in closed phials. I found no effect from hyposulphite. Selecting one containing sufficient ruthenium to render the sulphocyanide test available, I tried it, but equally without effect. The ruthenium had lost its power of reacting even in solutions which contained it in the proportion of  $\frac{1}{26}$ th of the iridium present.

It was immediately suspected that in consequence of the dilution it had become decomposed. A portion of the solution was then boiled with a little chlorhydric acid, when it at once recovered its sensibility to the various reagents.

It was long since pointed out by Claus that neutral solutions of sesquichloride of ruthenium were decomposed by boiling with separation of oxide of ruthenium, and that even without heat the separation took place by standing. But it appears that even acid solutions spontaneously decompose when very dilute if the excess of acid present is small.

I, therefore, recommend that in all cases where it is intended to test solutions for small quantities of Ru, that the solution be heated with a little dilute chlorhydric acid immediately previous. Of course, when the hyposulphite test is employed, the solution must be rendered alkaline with ammonia after boiling with the acid, and before adding the hyposulphite. Generally speaking it is advisable to use dilute solutions for testing for ruthenium; although it is then present in smaller quantity, it is immediately recognisable, because its reactions are then less marked by the iridium than when stronger solutions are employed.

The decomposition of dilute solutions of ruthenium, even when acid, may easily be observed without the aid of reagents. When such a solution of  $\text{Ru}_2\text{Cl}_3$  is very largely diluted with water, it soon assumes a purple black colour, and after a few hours nearly the whole of the Ru falls to the bottom, leaving the liquid almost colourless. This I have found to take place in solutions containing  $\text{Ru}_2\text{Cl}_3$ , 1; water, 5000.

When the solution is somewhat less largely diluted, it gradually assumes a purplish red colour by standing, and then behaves for the most part differently with reagents than ordinary solutions of  $\text{Ru}_2\text{Cl}_3$ .

**Detection of Ruthenium in Presence of Platinum by Hyposulphite of Soda.**—Small quantities of Pt scarcely affect the ruthenium reaction. When larger quantities are present, the colour produced is a mixture of that which would result from each separately, and therefore rather a wine than a rose colour.

**Mixtures of Ir and Pt, or of Ru, Ir, and Pt.**—In all these mixtures, the reaction of the hyposulphite is that which would result from a mixture of the separate colourations.

The hyposulphite is a valuable test for the purity of iridium, and affords an easy indication as to whether other metals of the platinum group are present. Let

† Claus remarks that this test fails when the Ru is in proportion to the Ir less than 1 to 10. As here the proportion is 1 of  $\text{Ru}_2\text{Cl}_3$  to 10 of iridium sal ammoniac, the proportion of Ru is even less than 1 to 10 of Ir. The hyposulphite test is not in the least affected by even a much larger proportion of Ir.



the chloriridiate of ammonium be boiled with HCl, and then ammonia be added until the solution assumes the pale olive colour produced by alkalies in solutions of bichloride of iridium. The solution should be sufficiently dilute that, after the ammonia has been added it becomes nearly colourless. Now add the hyposulphite and boil. If any increase of colour whatever takes place, it is a certain indication of impurity. If the liquid becomes rose colour, ruthenium is present; if wine colour, platinum is probably present; if brown, palladium is probably indicated.

(To be continued.)

### A New Method of Estimating Astringent Vegetable Matters, by M. COMMAILLE.

ACCORDING to Millon organic substances behave in three different ways when heated in solution with iodic acid. Some are burned by iodic acid when hydrocyanic is present; others are not attacked in the presence of hydrocyanic acid; lastly, there are some that are not oxidised by iodic acid under any circumstances. Vegetable astringent matters belong to the second group. The following method of estimating is founded upon the foregoing observations:—

Take a given volume of astringent liquid, add a few drops of hydrocyanic acid, then a given volume of a standard solution of iodic acid, of this there should be an excess, 0 gr. 5 being usually sufficient. Boil for a quarter of an hour. All the iodine set at liberty disappears. Decolorise the liquid, previously cooled and measured, by shaking it with well-washed animal charcoal; then estimate the remaining iodic acid.

It is now only needful to know how much iodic acid corresponds to a unit of tannin and gallic acid, to arrive at the weight of this body in the substance analysed.

It has been determined by means of iodide and iodate of silver that 1 gramme of gallic acid destroys on an average 2 gr. 366 of iodic acid, and that 1 gramme of tannin destroys 2 gr. 320 of iodic acid.

M. Commaille concludes by giving a table containing the quantities of astringent matters existing in a certain number of natural products.—*Bulletin de la Société Chimique.*

## TECHNICAL CHEMISTRY.

### On Cotton Seed and Cotton-seed Oil, by A. ADRIANI, M.D., &c.

IN addition to the short notice I gave on cotton seed (see p. 263, vol. x.), I now call attention to a few more particulars. It is to a certain extent a waste, or at least by product; the chief reason why the plant which produces the seed is cultivated is of course the cotton. Until within a few years the seeds, although it was known that they yielded an oil on being pressed, were left to decay and yield manure to the plants they were taken from. It will become a question of agricultural importance whether it is a sound and profitable proceeding to apply the seed as is done now to yield oil, and after expression of it, a cake to feed cattle. To the farmer the cotton seed will be of importance as food for cattle, after having been crushed. I understand its price is considerably lower than linseed, and it (the cotton seed) is, in nitrogenised and in fat-forming substances, in value not much below linseed. A bushel of cotton seed weighs about from 45 to 46 pounds, and the

relative proportion of shell or husks and kernel in 100 parts I found to be for Egyptian seed as 37.45 husks to 62.55 kernels.

Cotton seed, after having been first crushed, then finely ground, and then heated to about 170° or 190° Fahr., yields on being pressed on the large scale a quantity of oil varying from about 15 to 18 per cent. This oil exhibits the following properties:—It is dark brown red coloured, not quite clear nor limpid, containing in suspension, and perhaps to a certain extent in solution, a larger or smaller quantity of mucilaginous and albuminous matter; the fluidity of the oil is from twenty-eight to thirty times less than that of water; its density slightly also varies, for one sample, being an average of twenty-four casks, I found the density or specific gravity at 54° Fahr. (12.2 Cels.) 0.93074. Another sample, also fairly representing a large quantity of the oil, had at 58° Fahr. (14.4 Cels.) a specific gravity of 0.93169. The specific gravity of a portion of this sample, after having been submitted to a current of steam at 212°, and a thorough washing with boiling water, whereby, if not all, at least the greater portion of the vegetable impurities suspended in the oil were removed, and after filtering, was increased to 0.9343305 at 52° Fahr., care having of course been duly taken to have the sample which was taken for determining the specific gravity duly freed from any adhering water, by leaving a portion of the oil treated as first mentioned at 212° for several days.

This latter specific gravity is very near that of linseed oil, and the crude cotton-seed oil, in taste, odour, and other properties, save its colour, is very like linseed oil; it is akin to the latter, a drying oil, and may in many respects be applied as the latter. Crude cotton-seed oil is freely soluble in ether, sulphide of carbon, and benzole, but not sensibly in alcohol, neither, also, by application of heat; the alcohol, however, takes up from the oil a portion of the substance which imparts to the crude oil its peculiar colour. As regards the cause of the colour, I can positively state that from experiments I made, it is not, as might be perhaps presumed, due to the husks of the seeds. The husks of the carefully decorticated seeds do not yield anything sensibly soluble to either ether, alcohol, sulphide of carbon, or water; the cause of the colour has to be referred to the contents of small dark-coloured specks which even by the naked eye are seen dispersed over and through the yellowish-white mass of the kernels of the seeds; on examining a small section of the kernels under the microscope, the specks alluded to are observed to be cells filled with a rather dark pink coloured resinofatty substance, soluble in alcohol, ether, and also—but undergoing an alteration at the same time—in weak solutions of caustic alkalies and ammonia: on crushing in a mortar a few of the decorticated seeds a dark reddish brown fluid is at once observed. The original colour in the seeds, as long as atmospheric air has not had time to act, is yellowish-green, and having placed a few of the carefully decorticated seeds in alcohol, in a closed flask, and having evaporated the alcohol over sulphuric acid under the receiver of an air-pump, after exhausting the air, I obtained the substance alluded to with its original colour. It is therefore pretty certain that the peculiar colour of the crude oil is due to the oxidation of a peculiar substance contained in the seeds; still it cannot *strictiori sensu* be called a dye, for, though I tried to fix the colour with proper precautions, and with such menstrua as could not injure the mordants, I did not succeed in getting either upon cotton or woollen fabrics



properly mordanted any evidence of having to do with a dyeing material. The behaviour of the crude oil with reagents is certainly rather peculiar, but it should be borne in mind that the crude oil contains a large quantity of vegetable impurities, which no doubt play an important part in regard to the reagents wherewith the oil is brought in contact. I observed what follows:—

Concentrated sulphuric acid causes a beautiful purplish colour, which becomes stronger developed on stirring; after standing for twenty-four hours the mixture is much thickened and brownish red coloured.

Solution of bichromate of potassa in strong sulphuric acid being mixed with the oil causes an energetic reaction to take place; sulphurous acid is evolved, and the colour becomes deep blood red; after standing for nearly twenty-four hours the mixture exhibits a solid blackish mass.

On mixing the oil with strong nitric acid, the colour at first is dark olive green, but soon changes to light orange red; after twenty-four hours the oil was found solidified, and exhibited a dark orange red colour.

On mixing the oil with a solution of caustic potassa of a specific gravity of 1.22, the oil becomes thick and at first rather of a light yellowish colour, while the solution of kali becomes coloured. On stirring the mixture with a glass rod, those parts of the test-tube where air has more readily access to the mixture of oil and alkaline solution assume a tinge of blue purplish colour, somewhat akin to that which a solution of pyrogallie acid in potassa exhibits on exposure to air. After twenty-four hours the oil has become solidified. The bottom portion of the test-tube wherein the greater part of the solution of potassa had separated showed that solution deeply orange coloured. The blue purplish colour just alluded to was, if changed at all, a shade darker. With a solution of caustic soda the same phenomena were observed. On adding to the oil strong ammonia I observed a change of colour to yellowish green. Protonitrate of mercury in aqueous solution being mixed with the oil causes a change of colour to greenish yellow. After twenty-four hours the oil had become solidified and the colour dark olive green. Strong phosphoric acid, syrupyphosphoric acid, at first, on being added to the oil and shaken therewith, hardly effects any change, but after twenty-four hours I observed that the oil had become somewhat thicker and dark olive green coloured. On adding lime water, aqua calcis, to the oil it at once becomes solid and exhibits a dirty, brownish, yellow colour. The oil is not discoloured by sulphurous acid gas being passed through it; neither have some metallic combinations, as, for instance, chloride of zinc, chloride of tin, acetate of lead, any effect in withdrawing from the oil its peculiar colour, or if even at first some change appears to take place it is not permanent.

In its oxidised state, and no doubt also under the influence of vegetable substances met with in the oil, the colouring matter appears to have a predominating tendency to stick to fatty matter. The crude oil freezes at between 2° to 3° Cels., 26° to 28° Fahr. The oil is in its crude state excellently fit to yield soft and hard soap, and might advantageously replace linseed oil in dark coloured paints and varnishes, and perhaps in the manufacture of printing ink. The so-called refined oil, the best samples of which are fully equal in taste and colour to good olive oil, freezes between 28° and 32° Fahr., 2° to 0° Cels. I found its specific gravity at 61° Fahr. 1.6° Cels., to be 0.92647, its fluidity is about seventeen times less than that of water. In the strictest sense what is

called by the trade refined oil is a more or less pure oleic acid; this, at least, I found to be the case with the samples I had under examination. I abstain for the present from going into further details on this subject, and also refrain from making any observations on the constitution of this in many respects remarkable oil. I only wish to observe that, whereas hitherto the cotton crop is stated to be not exhausting to the soil, it becomes questionable whether the removal of the seed for commercial purposes instead of returning it to serve as manure to the plants it has been derived from, will not in shorter or longer time prove a bad policy.

In conclusion, I beg to tender my most sincere thanks to Professor W. A. Miller, who kindly gave me his permission to work on this subject in his laboratory at King's College. The refined oil is used for lubricating machinery, for burning in lamps, and the better kinds are no doubt mixed with other more expensive oils; being a perfectly sweet oil when well treated, I think it might answer well in many cases for pharmaceutical use.

## PHARMACY, TOXICOLOGY, &c.

### *Action of Bichloride of Mercury on Hydrocyanic Acid,* by MM. BUSSY and BUIGNET.

ON mixing bichloride of mercury in impalpable powder, with anhydrous hydrocyanic acid, no apparent action is produced. The salt remains in a solid state unaltered; no change takes place in the temperature, and the hydrocyanic acid boils at exactly the same point as when it is alone. There is, then, at least apparently, no action between these two substances.

But if, instead of using the acid in an anhydrous state it is diluted with a certain quantity of water, some curious and interesting phenomena are produced at the moment of mixing. For instance, by taking 3 grammes of anhydrous hydrocyanic acid, 12 grammes of water, and 15 of bichloride of mercury, the salt dissolves completely and instantaneously, like sugar in water. At the same time the temperature rises more than 15°, a circumstance which is more remarkable by contrasting with the change in the state of a salt which should produce cold by dissolving; then the liquid, which in the absence of the bichloride would boil at 40°, boils after the mixture only at 55°.

Hence it follows that in presence of water hydrocyanic acid and bichloride of mercury exercise an energetic reciprocal action, shown by the immediate dissolution of the salts by the elevation of the temperature at the moment of mixing, and by the higher boiling point of the liquid.

But what is the nature of this action? Is it, as might be supposed, a real chemical action, in consequence of which the elements of the two bodies are dissociated wholly or in part and recombined in different order? Is there, in fact, formation in greater or less quantity of cyanide of mercury, or of some quite different mercurial compound? The following experiments have been made with a view to solving this question:—

1. After having introduced into a small glass capsule 13 gr. 55 (1 equivalent) of bichloride of mercury, 2 gr. 70 (1 equivalent) of anhydrous hydrocyanic acid, and 10 gr. 80 (12 equivalents) of water, we placed the limpid solution resulting from this mixture, and which had given the above-described phenomena, under the receiver of an air-pump, above a second capsule containing quicklime. The experiment was made in the month of February at a temperature never exceeding +8°; at the



end of three weeks, the residue being perfectly dry, we examined it carefully, and found it to be formed simply of bichloride of mercury unmixed with cyanide or any other substance. Its weight, in fact, was 13 gr. 45.\*

It was completely soluble in ether.† Its aqueous solution gave with caustic potash the same yellow precipitate as that given by this alkali with the pure corrosive sublimate. Finally, introduced into a small test tube with an equal weight of hydrochloric acid, and heated slightly, it disengaged no hydrocyanic acid. The distilled product, collected in slightly alkaline water, gave no prussian blue by the successive action of ferrosulfuric sulphate and hydrochloric acid, while by adding merely a trace of mercury to the mixture in the tube, the characteristic reaction was immediately obtained.

2. The same mixture of hydrocyanic acid, bichloride of mercury, and water having been carefully introduced into a small retort and carefully distilled till dry, we found in the product of the distillation the 98 centièmes of hydrocyanic acid which had been introduced in the mixture.

These two experiments appear to us to prove in the clearest manner that the affinity between bichloride of mercury and hydrocyanic acid is a pure affinity of solution, occasioning no definite chemical combination. For if it be supposed that one is formed at the moment of mixing, it must also be supposed to be so unstable as to be destroyed merely by concentration in a vacuum at a temperature not exceeding 8°. However that may be, this is an important action of bichloride of mercury, and it renders an exact account for all that takes place in the preparation of anhydrous hydrocyanic acid by Gay-Lussac's process. It shows how a very considerable portion of this acid may be retained in a liquid from which it would normally be disengaged; how bichloride of mercury may be dissolved in a very much smaller quantity of water than is ordinarily required; how, in short, ammoniacal salt added to the preparation destroys this special affinity by the formation of *sel alembroth*, and thus renders it possible to obtain the whole of the hydrocyanic acid indicated by theory.

**Action of Protochloride of Mercury.**—The affinity of hydrocyanic acid for bichloride of mercury is sufficiently powerful to effect by simple contact, and without the aid of heat, the transformation of protochloride of mercury into corrosive sublimate. This may be easily proved by pouring on protochloride of mercury an aqueous solution of hydrocyanic acid. The salt, originally white, immediately becomes grey, owing to the precipitation of a portion of the mercury in a metallic state, and a proportionate quantity of bichloride of mercury is formed.‡

The transformation of protochloride of mercury is remarkable for being connected with no cyanic compound of this metal,—contrary to what has hitherto been ad-

mitted. It is a simple dividing of protochloride into bichloride and metallic mercury owing to the affinity of hydrocyanic acid for the corrosive sublimate, as is the case when the same protochloride is treated by hot hydrochloric acid, or by certain alkaline chlorides, which transform it equally and simply into bichloride and metallic mercury.

By taking, as we did, one gramme of protochloride of mercury, and treating it at several intervals by an aqueous solution containing  $\frac{1}{10}$ th of hydrocyanic acid until the latter no longer removes any trace of soluble matter, a black, insoluble residue, composed of metallic mercury, will remain; dried in the same tube in which the operation was performed, it weighed 0 gr. 42. On the other hand, hydrocyanic solutions, evaporated to dryness by gentle heat, leave a residue weighing 0 gr. 56—a number which, like the preceding, agrees with the theoretical division corresponding to the formula— $\text{Hg}_2\text{Cl} = \text{Hg} + \text{HgCl}$ .

Moreover, this saline residue gives all the characteristics of the pure corrosive sublimate. It is perfectly soluble in ether; its aqueous solution gives a yellow precipitate with caustic potash; it disengages no hydrocyanic acid when heated with hydrochloric acid in a test tube. It is then impossible to admit that any other combination is formed.

A very singular result of our observations, but one which might have been foreseen from the above, is that while the aqueous solution of hydrocyanic acid exercises an instantaneous and manifest action on protochloride of mercury; the anhydrous acid has, on the contrary, no sort of action on this salt.

By placing together, in a test-tube, 0 gr. 1 of protochloride of mercury and two or three cubic centimetres of pure hydrocyanic acid, nothing appreciable takes place, though the mixture is shaken so as to establish perfect contact between the two substances. This state of things is maintained during several weeks without any change taking place, especially if the mixture be kept from bright light. But on the addition of a few drops of water the reaction is produced immediately; the protochloride takes a grey tint, and some corrosive sublimate is found in the solution.

It is not only in the action of hydrocyanic acid on the two chlorides of mercury that the intervention of water is necessary. At every turn in the study of this acid are found new examples of the singular influence of water in determining reactions in which, from the nature of its elements, it would not appear to participate.

Thus, in presence of water, hydrocyanic acid is coloured immediately by the action of chloride of calcium; in the anhydrous state, on the contrary, it may remain in contact with the salt during several weeks without showing any sign of alteration.

In the same way aqueous hydrocyanic acid placed in the vacuum of a barometer will, after a time, be found to exercise a certain action on the mercury of the apparatus, while we have preserved anhydrous hydrocyanic acid for more than three months in the vacuum of a barometer, without its losing its transparency, and without any appreciable diminution in the elastic force of its vapour.—*Annales de Chimie et de Physique*, iii., 247. 64.

\* This figure does not represent the whole of the weight of sublimate experimented upon. The difference is to be ascribed to the projection of a small quantity of matter, in consequence of the rapid boiling of the liquid at the time the vacuum is formed.

† This solubility in ether would not suffice to prove the absence of cyanide of mercury, for this salt, in presence of the corrosive sublimate, forms the combination of chlorocyanide,  $\text{HgCyHgCl}$  described by M. Poggiale (*Comptes-Rendus de l'Académie des Sciences*, xxiii. 765), and we found that the whole of this combination dissolves in 20 parts of ether.

‡ This experiment recalls a well-known pharmaceutical fact that protochloride of mercury added to an emulsion of bitter almonds produces a blackish colour in consequence of the separation of metallic mercury, a phenomenon which does not occur when sweet almonds are substituted for bitter. Several explanations more or less satisfactory have been given of this fact, the therapeutic consequences of which M. Mialhe has given in a memoir in the *Journal de Pharmacie*, iii. 218 (1844).

**Testimonial to Dr. Odling.**—Dr. Odling's old pupils at Guy's Hospital have lately shown their appreciation of their late teacher by presenting him with a handsome claret jug and fish knife and fork.



## PROCEEDINGS OF SOCIETIES.

## ACADEMY OF SCIENCES.

December 26.

M. H. ST. CLAIRE DEVILLE presented a memoir "*On the Constitution of Sal Ammoniac and Vapour Densities.*" The author has shown that when ammoniacal gas and hydrochloric acid are brought in contact at  $360^{\circ}$  C., they disengage heat, and therefore combine at a temperature at which the density of the vapour of sal ammoniac gives that body an equivalent of eight volumes. The accuracy of this experiment has been called in question by Wanklyn and Robinson, so the author has repeated the experiment under more determined conditions, which he now describes. These conditions leave no doubt that the gases when brought in contact have been raised to the temperature of  $360^{\circ}$  C., and the elevation of temperature of this mixture is no less incontestable. The fact, then, and its consequences must be accepted. M. Deville subsequently offers the following difficulties for solution by the advocates of anomalous vapour densities. Sulphydric acid forms with ammonia two distinct, crystallised, and volatile compounds:— $\text{NH}_4\text{S}$ , sulphide of ammonium, or sulphydrate of ammonia;  $\text{NH}_4\text{S}\cdot\text{HS}$ , sulphydrate of sulphide of ammonium, or bisulphydrate of ammonia. Sulphide of ammonium represents four volumes of vapour, and its condensation is equal to one-third; sulphydric acid and ammonia therefore combine, and remain in combination at the temperature ( $100^{\circ}$  C., for example,) at which we take the vapour density. Sulphydrate of sulphide of ammonium represents eight volumes of vapour, and its condensation is 0. If we suppose its elements to be separated at the temperature at which the vapour density is taken ( $100^{\circ}$ ), we are obliged to suppose that it divides into ammonia and  $2\text{HS}$ , giving each four volumes, equal to eight volumes. But, in fact, at this temperature, it can only split into sulphide of ammonium and sulphydric acid, one representing four and the other two volumes—total, six volumes. If sulphydrate of sulphide of ammonium was decomposed into its own vapours, it should thus furnish six volumes; but experiment shows that it gives eight, hence it is not to be decomposed, and its vapour has nothing anomalous. The author goes on to argue that, in the cases of carbonic, sulphurous, and acetic acids, sulphur, &c., which give vapour densities varying with the temperature, it is really their co-efficients of dilatation which go on diminishing as the temperature increases, until they take the minimum value 0.00366, that which agrees with hydrogen. Supported on this variability of density is the hope that if a sufficiently high temperature could be reached the densities of phosphorus and arsenic would be diminished by half; this hope the experiments of the author and M. Troost do not allow him to share.

M. Kuhlmann gave a continuation of a memoir which he has entitled *Researches on the Crystallogenic Force*. Our readers will remember that the author made the discovery that a solution of sulphate of magnesia or sulphate of zinc, thickened with gum and distributed over a glass plate, covered that glass plate with crystallisations. In the present communication he describes the methods he has adopted for etching these crystallisations on the glass. For this purpose he mixes fluoride of copper or zinc with the solution of sulphate of magnesia, and afterwards exposes the plate to the action of sulphuretted hydrogen, or dips it into strong sulphuric acid. Fluorine is thus set free, and, acting on the glass, produces a picture of the crystals. The author states that even better engravings are produced by exposing the plate to gaseous fluoric acid. Mr. Bingham suggested to him the silvering of the back of the engraved plate, which no doubt has an exceedingly pretty effect. M. Kuhlmann has gone a step further,

and endeavoured, with some success, to fix his designs by vitrification. With this view he mixed easily vitrifiable substances (chromate of lead, for example) with his saline solutions, and, after heating in a muffle, found the crystalline design in relief coloured greenish by the oxide of chromium. He tried other colouring agents—oxides of copper, cobalt, and manganese—with more or less success. It is most important that these substances should be in the finest possible state of division. Porcelain and earthenware can be treated in the same way. M. Kuhlmann believes that he has founded a new industry; he has certainly done enough to set other experimentalists on the same pursuit.

A report "*On the Sucrates of Lime*" was read. Peligot has described two of these—a monobasic ( $\text{C}_{12}\text{H}_{11}\text{O}_{11}\cdot\text{CaO}$ ), obtained in the cold by the direct action of syrup on slaked lime; and a tribasic compound ( $\text{C}_{12}\text{H}_{11}\text{O}_{11}\cdot 3\text{CaO}$ ), precipitated when the solution of the former is boiled. MM. Boivin and Loiseau contested the accuracy of this, and appealed to the Academy for a commission to test the truth of their views and experiments. The commission now reported at some length, with the evident object of making things agreeable to both parties, and gave the opponents of M. Peligot the credit of having discovered a bibasic sucrate of lime.

M. Maumené presented a note "*On the Density of Carbon in its Combinations.*" The author appears to be in search of artificial diamonds, and sees that the first step must be to find a carbon compound in which the carbon has the same density as the diamond. He finds this to be the case in oil of turpentine; but that would seem to be a hopeless body to experiment upon. More likely are the iodides of carbon, in which also the author believes the carbon to have the density 3.53. These bodies, he says, must be very easy to decompose, since they have never yet been isolated, because of their instability. Serulla's process for the preparation of one iodide, he tells us, does not answer; but Hoffmann quotes an experiment which seems to involve the formation of a real iodide of carbon. It is the decomposition of iodoform in a sealed tube heated to  $150^{\circ}$  C. In this experiment it is said that biniodide of methylene  $\text{C}_2\text{H}_2\text{I}_2$  is produced; and according to M. Maumené the decomposition must be as follows:—



Hoffmann speaks only of the first derivative; but the second has greater importance, for it may serve for the preparation of the diamond. It is not known, however; and we may heartily wish the author success in his search for it.

## NOTICES OF BOOKS.

*On the Chemistry of the Feeding of Animals for the Production of Meat and Manure.* By J. B. LAWES, F.R.S., F.C.S. (Paper read before the Royal Dublin Society.) 1864.

How to make beef and mutton is a question which often arises in a man's mind, especially at this season of the year. To agriculturists, however, the question has a more permanent and practical interest; and they will read this paper, we have no doubt, with close attention. Whether they will be much enlightened by it depends upon several circumstances; but the most favourably circumstanced reader will most likely agree with the remark made by the author at the end of the paper—viz., that the subject of the chemistry of feeding is essentially an intricate one, and that much remains still to be determined by careful investigation. For what Mr. Lawes has done he deserves our best thanks: we hope he will continue his valuable experiments, and some day bring



the practical results of them within the comprehension of the ordinary agricultural intellect.

We have no space to go at length into the question of the chemistry of feeding; but we must make room for an extract or two:—

“The actual amounts of food,” says Mr. Lawes, “assumed to be required for the production of 100lbs. of live weight are—for oxen, 250lbs. of oil-cake, 600lbs. of clover-hay chaff, and 3,500lbs. of swedes; for sheep, 250lbs. of oil-cake, 300lbs. of clover-hay chaff, and 4,000lbs. of swedes; and for pigs, 500lbs. of barley-meal.” Thus we see in the case of oxen 4,350lbs. of food, containing 1,109lbs. of dry substance, consumed to produce 100lbs. of live weight; and these 100lbs. of increase actually represent only 9lbs. of lean and 58lbs. of fat, the bulk of the remainder 314lbs. being water.

Considering the difference in the size of the animal, it would seem strange, at first sight, that a sheep should consume 4,550lbs. of food to gain 100lbs. increase of weight—that is, 200lbs. more than an ox to gain the same increase. But the food in this case contains only 912lbs. of dry material, which still only furnishes 7½lbs. of lean to 63lbs. of fat. A pig, on 500lbs. of barley-meal, or 420lbs. of dry material, produces 7lbs. of lean to 66lbs. of fat.

Our readers will see from this how small a portion of food is stored up in the body, and how much is necessary to keep the living machine in action.

In human adults, the whole of whose food is in most cases used up in keeping the machine going, this does not look so extraordinary; but we must confess to some astonishment at seeing that an animal at the age selected for fattening should require so much.

Some natural questions suggest themselves also as to the possibility of varying the proportions of fat and lean produced. Here we see that the highest proportion in the case of beef is 9 per cent. Now what should be the proportion in a normal healthy animal? Taking all the soft parts, is 9 per cent. of nitrogenous matter to 58 per cent. of non-nitrogenised the most that Nature will furnish?

We can hardly suppose that Mr. Lawes has not directed his attention to this question. After every Smithfield show it is regularly asked whether animals are fed for food, or for the tallowchandler and soap boiler? If it be found impossible to have more than 9 per cent. nitrogenous matter laid up, it must be submitted to; but we think the matter deserves further investigation.

We have stated nothing about the relation of the food to the manure produced. All over-nourished animals, mankind included, necessarily make rich manure, and a wise economist will no doubt consider this in feeding his stock. But it should be remembered that an excess of nitrogen in food always tends to the production of diseased conditions of body, manifestations of which may possibly be found in the flesh of an overfed ox. We believe, indeed, that it is impossible to regard an ordinary prize fat ox, sheep, or pig as a healthy animal, and are disposed to question the goodness of their flesh as food.

This, however, is a physiologist's question, and we must quit the subject now, only expressing a hope that Mr. Lawes will continue his experiments, and soon, dropping for the time the scientific jargon about nitrogenised and non-nitrogenised matters, tell the farmer in plain English the best way to feed his cattle.

densation of vapours on the surface of solid bodies, the other by M. des Cloizeaux, on the optical properties of castor and petalite. The only other article is by MM. Christophle and Beilstein, “On the Colouration of the Flame of Hydrogen by Phosphorus and its Compounds, and the Spectrum of Phosphorus.” Phosphorus communicates a green colour to the hydrogen flame, and gives in the spectrum two magnificent green lines, and a third fainter between the two former and near to that of sodium. The two lines  $\alpha$  and  $\beta$  have about the same intensity; the line  $\gamma$  is fainter, and the line  $\alpha$  is the strongest. The lines P  $\beta$  and Ba  $\delta$  correspond perfectly, and the lines P  $\alpha$  and Ba  $\gamma$  are only separated by two divisions. Many experiments gave the authors identical results. They suggest the spectrum experiment in toxicological investigation. They further state that the blue colour of the flame of hydrogen obtained by means of iron is due to phosphorus.

*Annalen der Chemie und Pharmacie.* November, 1864.

THE first paper in this journal is by E. Reichenbach and F. Beilstein, “Researches on Isomerism in the Benzoic Series.” In it the author describes *dracylic acid*, which appears to be identical with benzoic acid. It is obtained by treating a boiling alcoholic solution of amidodracylic acid with nitrous acid. In a notice of Hofmann's test for tyrosine Meyer confirms its accuracy. The test is a solution of mercuric nitrate, which boiled with a solution of tyrosin gives a flocculent red precipitate, and leaves a nearly colourless liquor. A short notice of “*The Basic Compounds of Aldehydes with Ammonia*,” by Petersen, gives a meagre account of the compounds of benzoic, cinnamic, and anisic and valeric aldehydes. A. Schoyen describes “*A New Isomer of Tartaric Acid*,” which he names *glycotartaric acid*. When glyoxal, the aldehyde of oxalic acid, is mixed with strong hydrocyanic acid, a compound is formed which boiled with caustic potash evolves ammonia. When this evolution ceases the liquor is neutralised with acetic acid, and precipitated with acetate of lead. The lead precipitate decomposed by sulphuretted hydrogen gives a solution of the acid in question. Of a paper by R. Otto, “*On the Action of Chlorine on Cyanide of Ethyl*,” we can only give the title. A communication by R. Fittig, “*On some Derivatives of Diphenyl*,” contains an account of the bromine and sulphur compounds. Several short papers by Weltzien follow, which are of no particular interest. In one of these, however, “*On the Action of Ammonia or Ignited Carbon, and the Formation of Cyanogen*,” the author states in opposition to Kuhlmann, that no hydrocarbon is produced in the action, but only cyanide of ammonium, hydrogen, and nitrogen. A candid communication by Bahr admits “*The Probable Identity of Wasium with Thorium*,” and so far contradicts Nickles, who has stated that wasium was impure yttria; and also Delafontaine, who asserted that it was a mixture of cerium and didymium.

We may return to this paper at some other time. All the other papers in this number of the *Annalen* have appeared or been noticed in the *CHEMICAL NEWS*.

*Watts's Dictionary of Chemistry, &c.* Part XXIII.  
Longman and Co.

THE present part carries us from Magnesium to Menthol, and includes two excellent articles, one on Magnetism and the other on Manures.

*Annales de Chimie et de Physique.* November, 1864.

THIS journal contains several papers with which our readers have already been made familiar; the completion of MM. Buignet and Bussy's paper on Hydrocyanic Acid, the researches on Copper by MM. Millon and Commaille, M. Lamy on Thallic Alcohols, and M. Maumené's general theory of Affinity, for example. Besides these, there are two papers on physics, one by M. Magnus, on the con-

## NOTICES OF PATENTS.

1058. *Treating Titanic Iron Sands.* B. F. BRUNEL, Brussels.  
Dated April 27, 1864. (Not proceeded with.)

THE inventor proposes to apply the native iron-sands of New Zealand and Italy to several new purposes. As a grinding material and substitute for emery powder, the



mineral is to be employed either in its natural condition or after pulverisation between iron rollers, which by a stream of hot water are kept at a temperature ranging between  $140^{\circ}$  and  $175^{\circ}$  Fahrenheit. The iron sand may also be used as a pigment, or as the chief ingredient of a metallic cement or luting for uniting the joints of metal and other pipes. For these last-named purposes the mineral is reduced to the state of an impalpable powder in the mill, and afterwards dried by a current of hot air. The specification describes also the means of polarising the particles of magnetic oxide of iron by the employment of electric coils, &c., which the inventor deems a great advantage when about to be applied as a paint to surfaces of iron or steel.

1081. *Treating Wood and other Ligneous Substances in order to Produce Alcohol, and to obtain the Cellular Tissue or Fibre from such Substances, applicable to the Manufacture of Paper and other Uses.* R. A. BROOMAN, Fleet Street, London. A communication. Dated April 29, 1864.

THE sawdust, wood raspings, &c., are to be boiled with dilute hydrochloric acid of a strength varying from 5 to 12 per cent. of real acid, and for a time regulated according to the state of division and other circumstances from six to fifteen hours. The glucose thus formed may afterwards be converted into alcohol by the ordinary fermentation process, and the residual cellular fibres or tissue employed in the manufacture of millboards and paper.

1092. *Manufacture of Syrups.* F. LEISZ, New Coventry Street, Leicester Square, London. A communication. Dated April 30, 1864. (Not proceeded with.)

IN a manner very similar to the preceding the inventor treats potato-starch with dilute sulphuric acid, according to the well-known process, for its conversion into glucose, and afterwards neutralises the excess of acid with chalk. The saccharine solution is then poured off from the sediment of sulphate of lime, and concentrated to a syrup in the vacuum apparatus.

1088. *Improvements in the Purification of Gas, and in Obtaining a Valuable Product in the process, and for the Preparation of Some of the Materials to be Used in the said Purification.* F. C. HILLS, Deptford. Dated April 29, 1864.

THE inventor supplements his former process for the preparation of a gas-purifying material by adding to the sulphate of iron formerly employed either sulphate of magnesia or precipitated sulphate of lime, by which means the absorption both of ammonia and sulphuretted hydrogen from the foul gas is rendered more certain.

1113. *Lubricating Compounds.* P. WARD, Bristol. Dated May 3, 1864.

FOR lubricating steam-engine cylinders, the patentee uses the lime-compound of a fatty acid, or any other earthy soap, dissolved in petroleum oil. To this mixture may be added, if desired, a certain proportion of tallow, crude grease, or of any good lubricating oil.

1119. *Treating Animal Charcoal.* E. BEANES, Argyll Street, London. Dated May 4, 1864. (Not proceeded with.)

FOR the purpose of renovating animal charcoal (bone-black) which has been repeatedly employed in decolourising sugar and other solutions, it is proposed to treat it with nitrous acid, sal-ammoniac, nitrate of ammonia, or even carbonic acid, for the purpose of dissolving out the phosphate of lime, and other mineral salts, when, after thorough washing with water (and drying), the animal charcoal becomes again serviceable for renewed application.

It is well known, however, that, after the removal of the

lime salts by washing with acid, the animal charcoal is not nearly so efficacious an agent for the removal of colouring matters as in its original form of bone-black.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

#### *Grants of Provisional Protection for Six Months.*

2943. R. A. Brooman, Fleet Street, "An improved lighting composition and an improved apparatus for lighting, together with the employment of pyrophorous materials for the lighting of cigars, pipes, and other articles."—A communication from Charles de Chaugy, Brussels.—Petition recorded Nov. 24, 1864.

3010.—E. Bevan, Birkenhead, and A. Fleming, Liverpool, "An improvement in the construction of bottles, jars, and like vessels of capacity, and improved means for securing or fastening corks and other stoppers therein."—Dec. 3, 1864.

3030.—T. Atkins, Fleet Street, "Combining apparatus used for regulating, adjusting, and indicating the supply and flow of hydrocarbon and other gases and vapours, with improved apparatus for effecting the perfect carburation and purification of such gases and vapours for illuminating and other purposes, and for improvements in the construction of the apparatus for effecting the same."—Dec. 6, 1864.

3062. R. A. Brooman, Fleet Street, "Improvements in apparatus for cooling and freezing."—A communication from Marcar Beylih'g, Constantinople, Turkey.—Dec. 8, 1864.

#### *Notices to Proceed.*

2029. S. Moore, Liverpool Street, "Improvements in electro-gilding."—Aug. 15, 1864.

2039. C. F. Darcagne, Upper Thames Street, "A new mode of treating or preparing the sorgho plant (*holchus sorghum*) so as to render the fibre thereof useful in manufactures as a substitute for horsehair and otherwise."—Aug. 16, 1864.

2072. F. Taylor, Romsey, "Improvements in apparatus for receiving, drying, and deodorising human excrement."—Aug. 22, 1864.

2095. R. Beard, jun., Clapham, and W. Downing, Battersea, "Improvements in the manufacture of artificial leather, and in colouring, dyeing, or finishing the same, which latter improvements are also applicable to the colouring or dyeing of the ordinary leather cloth."—Aug. 24, 1864.

2100. R. A. Brooman, Fleet Street, "Improved apparatus for lighting and for firing charges in mines and other blasting operations."—A communication from A. Dumas, Privas, France.—Aug. 25, 1864.

2104. R. Hill, Birmingham, "Improvements in the manufacture of iron and steel."—Aug. 26, 1864.

2181. W. H. Perrin, Sudbury, "Improvements in preparing colouring matters for dyeing and printing."—Sept. 6, 1864.

2794. J. McCall, Houndsditch, and B. G. Sloper, Walthamstow, "Improvements in preserving fresh meat, poultry, game, and fish, and in vessels employed therein."—Nov. 10, 1864.

2854. J. Rowley, Camberwell, "Improvements in the manufacture of printer's ink."—Nov. 15, 1864.

## CORRESPONDENCE.

### *Continental Science.*

PARIS, January 3.

LET me notice first the re-opening of the laboratory in which MM. Fremy and Chevreul allow young men who have ideas to work out to make their researches *gratis*. Pure chemistry is not often a profitable study pecuniarily, and apparatus is sometimes expensive; but in this esta-



blishment all devoted young chemists find a hearty welcome and every encouragement, together with whatever may be necessary for carrying on their experiments. This is only the second season, and we have hardly had time to see whether the opportunities offered have been successfully seized upon; but the generous founders deserve to see good results from their generosity.

Another gratuitous institution deserves a passing notice—the evening lectures at the Sorbonne. These lectures most resemble the lectures given to the *élite* of the London scientific world at the Royal Institution, but are open to all who apply for tickets in time. The scientific lectures are illustrated in Royal Institution style, and the experiments are always attractive. In his lectures on the conversion of liquids into vapour last week, M. Boutau used very ingeniously the electric light and thermo-electric pile to make changes of temperature visible to a large audience. He also showed Mr. Groves's experiments on ebullition. Lastly, he spoke of and illustrated the spheroidal condition of liquids, and promised to repeat Bou-tigny's experiment by putting his hand into melted lead; but he only melted the lead, and did not put his hand into it, so the audience went away dissatisfied.

M. Ronquayrol, an engineer, has invented a new apparatus for supplying divers with air. It consists of a reservoir of compressed air, on the top of which is a chamber closed by an india-rubber cap. By a simple arrangement, just sufficient air for one inspiration is let into this chamber, and passes thence to the mouth of the diver. The chamber thus forms a sort of artificial lung.

A method of purifying water was patented here some time ago by M. Scheurer, of Freiberg, which has not, I think, been noticed in England. The author makes use of neutral persulphate of iron. The quantity of this agent employed depends, of course, upon the amount of impurity present, which is easily determined from time to time as may be required. Soon after the sulphate is added it decomposes and deposits an insoluble basic salt, the particles of which carry down with them the suspended impurities. The invention seems to have but a limited application, since the dissolved impurities are left unaffected.

Dr. Hofmann, in his valuable Exhibition Report, pointed out how great a blessing cheap caustic baryta would be to manufacturing chemists. A M. Szerlecki has devised a process which will not, perhaps, realise all the conditions, but which, nevertheless, deserves attention. He commences, of course, with converting the sulphate of barium into sulphide, and this latter he boils with oxide of copper, and thus procures sulphide of copper and caustic baryta. The sulphide of copper he either converts into sulphate or roasts to recover the oxide. The process is very simple, and seems quite practicable. If so, here is the change which will "revolutionise the alkali manufacture."

I may here mention another industrial operation which has just come into action, and which somewhat resembles a process described in the Exhibition Report. It is a process for recovering the cotton from mixed fabrics of wool and cotton. Mr. F. O. Ward, you will remember, submits rags of these fabrics to the action of superheated steam under pressure, and so converts the wool into an impalpable powder "ultimate of ammonia," which serves as a manure, while the cotton freed from the dust is available for paper. M.M. Gelis and Dussart here appear to submit the rags to a regulated heat in retorts, and so obtain from the wool ammonia and a substance which is available in the manufacture of prussiate of potash, and among other secondary products, gas to light their works or heat part of their retorts, and after all this find the cotton remaining, and available for paper.

Another ingenious, but it would seem not original, discovery, is that of M. Cauderay, who describes an electro-chemical method of pointing pins and needles. It is

known that if the two electrodes of copper, iron, or steel are set vertically in acidulated water, and reaching nearly to each other, the positive very quickly becomes pointed. The experiment can of course be made by making the positive pole of a number of wires, and carefully regulating the distance of the negative pole. Two or three Bunsen's cells only are required to do the work. Considering the diseases which come of pointing pins and needles in the usual way, this method certainly deserves some attention, although some supplementary polishing would seem inevitably required. M. Gaston Plante claims the first mention of the bare fact in 1860; but allows the ingenious application to the manufacture of pins and needles to M. Cauderay.

## MISCELLANEOUS.

**Lenoir's Gas-Engine.**—M. Lenoir has succeeded in effecting a long-desired object—namely, the construction of a powerful engine, which dispenses with steam as the motive force. In appearance the Lenoir engine is very much like a horizontal steam-engine, having a cylinder, piston, crank shaft, and fly wheel; the cylinder has the necessary slide arrangements for the admission of coal-gas and atmospheric air in due proportions, which, at the proper moment, is ignited by the electric spark—contact being made and broken by the rotary action of the crank shaft—the expansive force, consequent on the ignition, gives motion to the piston on each side alternately. The cylinder has a water jacket surrounding it, through which a stream of hot or cold water is kept gradually flowing, to absorb any excess of heat. The mixture exploded is about eleven volumes of air to one of gas. The consumption of gas is as near as may be seventy feet per horse power per hour of actual work, giving a cost, with gas at 4s. 6d. per 1000 feet, of about 4d. Besides this extraordinary cheapness, the engine is recommended by its simplicity, cleanliness, and safety. When set in motion the machine requires no attention, and the batteries only require to be charged once a week. The engine may be seen at work daily at 40, Cranbourn Street.

**Royal Horticultural Gardens.**—Dr. Septimus Piesse has, during the past week, lectured at the above gardens on "Perfumes, Flower-gardening, and the Methods of Obtaining the Odours of Plants." The lecturer gave an excellent account of the process of *enfleurage* as it is followed in the Valley of the Var, and also the methods of cultivation adopted in the flower gardens there. The object of the lecture, it seems, was to instruct young gardeners who are emigrating to warm British colonies, so that they might lay the foundation of the same industry in some of our possessions.

**Royal Polytechnic Institution.**—Seldom have instruction and amusement been so happily combined as in the varied entertainments provided at this old and deservedly popular Institution. The Christmas programme includes several novelties, which will be witnessed with pleasure both by young and old. The Ghost Lecture has undergone a further modification in the hands of Mr. Pepper, and is about to enter upon the third year of its existence. The present representation is descriptive of the Hindoo custom of sacrificing the widow upon the funeral pile of her departed husband, and is ingeniously shown by a series of tableaux portraying the fanciful incidents of an Indian maiden's dream—her courtship, marriage, the departure of her soldier-husband, his mortal wound in combat, and the final immolation of the living with the dead on the funeral pile. The scenery in itself is well arranged and very effective, and the ghostly combat of five soldiers altogether unprecedented as a spectral representation. A fairy tale, by the Brothers Grimm, entitled "Snow-white and Rosy-red," is likewise well told and illustrated by



five spectral tableaux; and a very clever optical extravaganza recounting the truly wonderful adventures of Baron Munchausen is humourously described by Mr. R. Coote. The Shadow Scene has been so often exhibited at the Crystal Palace and the Polytechnic by Mr. Pepper that it cannot assert a claim to novelty; but in connection with the old pantomimic representation a novel effect has been introduced, which, invented by Mr. Cheshire, shows a curious phenomenon, in the shape of a combination of moving limbs, arms and legs, without any visible body and head. A revival of the old Physioscope carries back the memory to an early period, when an elderly gentleman, of gigantic proportions and benignant countenance, used to take a glass of wine with us at the Polytechnic, and satisfy his hunger by swallowing in a mouthful a liveried attendant. A series of photographic reproductions from statuary at the late International Exhibition, the work of the London Stereoscopic Company, is exhibited on the large screen by the oxyhydrogen light. Some of these are very effective, particularly "The Finding of Moses" and "Defending the Pass;" but others, and especially the celebrated figures by Monti, show in the high lights a granulation which mars the general effect. These obvious defects are no doubt partly attributable to the dark-grey patches and veins in the marble, which have already given the sculptor so much anxiety; but they do not appear to be wholly attributable to this cause. The Magic Tub will have a charm for the juveniles on Thursdays, whilst Mr. Stokes is aiding the "Memory" of the elder section of the company, and Signor Blitz will amuse all alike with his wonderful troop of dancing dinner plates.

**Popular Science.**—We copy, for the amusement of our readers, the following extracts from an article on the late explosion at Manchester, which appeared in a journal making, as our readers will see, some pretension to science: "The use of oxygen gas was never more prevalent than at present. In the exhibition of the patent ghost of Messrs. Pepper and Dircks it is an indispensable adjunct, and it has become a substitute, in almost all cases, for the coloured fires so long used for the production of supernatural 'effects' at our theatres. Again, the oxyhydrogen light, which depends for its extreme brilliancy upon oxygen, is extensively employed in the illustration of scientific lectures and for the purposes of popular amusement. The coloured lights, it need not be said, are produced by the transmission of the rays of oxygen in combustion through heated lime and stained glass, and were first used by Professor Ansell, at the Panopticon, some years since. By the introduction of these and similar scientific improvements, oxygen has become almost a necessity, although its expansive and explosive properties make it as dangerous to deal with as high-pressure steam or gunpowder—that is, in the hands of the tyro in chemistry. The accidents of Saturday night last arose principally from the palpable ignorance or want of observation of the unfortunate photographer. In the elimination of oxygen it is of the greatest importance that the closest attention should be paid to the evolvment of the gas, and, when ebullition ceases, that the heat which causes it should also cease to play upon the retort. These points poor Crowther appears to have neglected entirely; hence the super-heating and consequent expansion of the gas to the bursting strain. The oxygen most extensively used for the purposes named is eliminated from mixtures of chlorate of potassa and manganese, and all chemists are aware that the operation goes on with great rapidity. They accordingly provide apparatuses of sufficient strength to resist sudden pressure, and they are especially careful in apportioning the materials correctly. If too much manganese be employed rapid fusion ensues, and the fused mass, driven by the evolving gas, quickly chokes the conducting tube, shuts up the safety-valve as it were, and an explosion necessarily follows, as it would in a steam-boiler

under parallel circumstances. The proper proportions in which chlorate of potassa and manganese should be mixed are, a quarter of a pound of the former to a quarter of an ounce of the latter. The manganese really undergoes scarcely any chemical change, but acts principally by catalysis. This combination, if heated slowly over a gas flame, which, from the power we have of regulating its volume, is by far the best medium for effecting elimination, evolves oxygen gas, at first slowly, but soon with much rapidity; finally, the masses ignites, or rather glows into a red heat, and the oxygen is then given off with violence. These facts assuredly lead to the conclusion that under no circumstances should an ordinary fire be used for the elimination, or manufacture, as it is sometimes absurdly termed, of oxygen gas, from chlorate of potassa and manganese. It is safer to use glass vessels than those of any other material, because, if an explosion unfortunately happens, in spite of all precautions, the damage done to life and limb will then inevitably be comparatively small. For eliminating oxygen on a small scale, a Florence oil-flask will answer as a retort exceedingly well, but, for extensive operations, an iron bottle, and the employment of black oxide of manganese as a catalyst, will be found advantageous and safe." To this we may append a paragraph extracted from the *Times* of Tuesday last:—

**"Uses of Petroleum.**—Hitherto this mineral oil has been almost exclusively spoken of as an illuminating substance, and as such it has at least as many adversaries as it has friends. But it possesses also other qualities, the value of which is less open to dispute. We mentioned a few days ago the property it possesses of destroying the parasites that prey upon the human body, and we will now add that it may become one of the most important auxiliaries in the art of dyeing, in which it is calculated to produce quite a revolution, it having just been discovered that it contains the principles of aniline, the well-known vegetable base derived from indigo, and which is now so commonly used for producing splendid rose-coloured stuffs. Aniline has hitherto been obtained by treating indigo with a concentrated solution of potash, whereby a brownish oily substance is formed, which by distillation yields pure aniline, a clear colourless liquid, having the smell of wine, but a corrosive and poisonous taste. The salts of aniline are also colourless, but rapidly assume a mellow rose colour by exposure to the air. White wood dipped into a solution of a salt of aniline takes a deep yellow colour. Hydrochloric acid turns these salts green, blue, or black, according to the concentrated state of the solutions. For the present, experiments are still in progress for extracting aniline from petroleum at a cheap cost, and there is every reason to suppose that these efforts will be crowned with success. Certain odoriferous ethers may also be extracted from petroleum, and there is even a talk of substituting petroleum for coal or coke for steam purposes."—Probably so many misstatements as are to be found in this paragraph have seldom been compressed into the same number of words.

## ANSWERS TO CORRESPONDENTS.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

C. R.—Yes, under favourable circumstances.

G. will see that his suggestion has been adopted.

R. K.—Yes, the colourless base, precipitated by carbonate of soda.

**Books Received.**—Chymical Magic, by S. Piesse, Ph.D.; Quarterly Journal of Microscopical Science; Hardwicke's Science Gossip; On Microscopical Research in Relation to Pharmacy, by H. Deane, F.L.S., and H. B. Brady, F.L.S.



## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Notes on the Platinum Metals, by M. CAREY LEA.*

### PART II.\*

(Continued from page 5.)

#### (IV.)

**Reactions with Tetrathionic Acid.**—Tetrathionic acid is capable of giving useful reactions with metals of the platinum group, and especially with palladium.

$\text{Ru}_2\text{Cl}_3$  boiled with tetrathionic acid is somewhat decolorised, and finally becomes muddy and greyish.

$\text{RuCl}_2$  boiled with tetrathionic acid, gradually darkens in colour, becomes muddy, and finally throws down a brown precipitate. But if the acid be at first supersaturated with ammonia, the solution becomes yellow and remains clear.

$\text{Ir}_2\text{Cl}_3$ , when boiled with tetrathionic acid, the pale, almost colourless dilute solution darkens rapidly, and by some moments' boiling becomes a deep wine brown, remaining clear. If the acid be first supersaturated with ammonia, the reaction does not take place.

$\text{IrCl}_2$  is quickly decolorised by boiling with the acid. The decolorised solution does not darken by further boiling.

$\text{PtCl}_2$  is instantly precipitated in the cold by tetrathionic acid. The precipitate has a dark chocolate brown colour. This precipitation without heat is highly characteristic of the protochloride of palladium, and the test is of great delicacy. A single drop of a rather dilute palladium solution was added to two ounces of water. In a few drops of this very dilute solution, the presence of palladium was made evident by this test. When the quantity of palladium present is so very minute as in this case, no precipitation takes place, but a brown colouration is developed. And as this colouration is produced in the cold, it is highly characteristic of the metal in question.

$\text{PtCl}_2$ .—Tetrathionic acid produces no effect in the cold. By boiling, a wine brown colour is developed, but no precipitation takes place.

As this test for palladium appeared likely to be a valuable one, a series of experiments was undertaken to ascertain whether, like so many of the old tests for metals of the platinum group, the reaction would be affected by the presence of other members of the group. Mixtures were therefore made of solution of protochloride of palladium with the following substances respectively:—Sesquichloride of ruthenium, bichloride of ruthenium, sesquichloride of iridium, bichloride of iridium, and bichloride of platinum.

In all these cases it was found that the reaction was obtained without difficulty, so that this test is capable of detecting palladium with ease in the presence of either of the above-named compounds. When but little palladium is present, the reaction commences with a darkening of the solution, and the precipitate falls only after an interval of one or two minutes or longer, according to the degree of dilution.

#### (V.)

**Reactions with Sulphate of Quinia.**—With sulphate of quinia, protochloride of palladium gives a bulky buff coloured precipitate, which becomes somewhat blackish on boiling. Neither ruthenium nor iridium give similar reactions.

#### (VI.)

**Reactions with Protochloride of Tin.**— $\text{Ru}_2\text{Cl}_3$ , boiled with  $\text{SnCl}$ , becomes perfectly colourless, if the solution is very dilute. Stronger solutions show a pale straw colour.

$\text{RuCl}_2$ , boiled with a small quantity of  $\text{SnCl}$ , gives a buff coloured precipitate, which dissolves in an excess of the precipitant, to a solution which, by further treating, passes to a splendid blood red of great intensity.

The buff coloured precipitate is soluble in solution of potash, producing an intense brown liquid.

$\text{Ir}_2\text{Cl}_3$ .—When the sesquichloride of iridium and ammonium is boiled with  $\text{SnCl}$ , and potash added in sufficient quantity to re-dissolve the precipitate which it at first produces, further boiling produces an abundant leather coloured precipitate, which is insoluble in any excess of potash.

I felt much interested to observe whether this reaction would take place in the presence of sesquichloride of ruthenium in the solution, and had the satisfaction to find that it did so. We thus have a mode of detecting iridium in the presence of ruthenium which offers certain advantages.

The best way to observe the reaction is as follows:—To the solution of sesquichloride of ruthenium, add a little acidulated protochloride of tin, and boil till the colour disappears, and then add excess of potash. The liquid should be perfectly clear and very nearly colourless. The addition of a single drop of dilute solution of sesquichloride of iridium communicates a yellow colour, which rapidly deepens by boiling, and an abundant leather-coloured precipitate falls. The almost perfect decolorisation of the ruthenium solution by the protochloride of tin adds to the nicety of this reaction. Those only who have been annoyed by the extreme difficulty of getting any indication of the presence of small quantities of iridium in ruthenium solutions will appreciate the full value of this test.

#### (VII.)

**Reactions with Ammonio-Chloride of Zinc.**—A solution of chloride of zinc in excess of ammonia gives an interesting and beautiful series of reactions with the metals of the platinum group. The metallic solutions which are to be subjected to this test must be either neutral or slightly acid. The presence of alkali in excess, or of acid in large excess, naturally interferes with these reactions.

To obtain the zinc solution in proper condition, chloride of zinc must be added to ammonia until the smell of ammonia becomes tolerably faint, and a considerable proportion of zinc oxide remains undissolved. The liquid is then to be filtered off, and should be used without too much delay. In this condition the affinities are in a state of very unstable equilibrium. The addition of even a few drops of water produces a precipitate. It is precisely this instability which gives the solution its value for the purpose under consideration. When it is added to a solution of a platinum metal, the precipitate which falls carries with it a part or the whole of the platinum metal, which imparts to it a characteristic colouration.

The following are the reactions:—

$\text{Ru}_2\text{Cl}_3$ —a brown precipitate: the solution becomes colourless.

$\text{RuCl}_2$ —a rose-coloured precipitate: the solution becomes colourless.

$\text{Ir}_2\text{Cl}_3$ —a pale buff precipitate: the solution becomes colourless, or nearly so.

$\text{IrCl}_2$ —a fire-red precipitate: solution decolorised.

\* *Am. Journ. Science and Arts*, No. 113, Vol. xxxviii.



With platinum and palladium, the tendency of ammonia to form double salts interferes, and prevents any characteristic reaction from the zinc solution.

## (VIII.)

**Reactions with Solutions of Ferridcyanide of Potassium and Caustic Soda.**—When this solution is added to ruthenium and iridium solutions, the following reactions are obtained:—

$\text{Ru}_2\text{Cl}_3$ —bright yellow liquid.

$\text{RuCl}_2$ —the same, but more on a wine colour.

$\text{Ir}_2\text{Cl}_3$ —When to a slightly acid solution of sesquichloride of iridium, enough of the solution in question is added to make the liquid strongly alkaline, a green colouration is produced at once, which by boiling becomes olive.

But if the iridium solution be first rendered alkaline with ammonia, the addition of the above reagent gives a bright yellow colouration, which by boiling becomes a deep wine red.

## (IX.)

**Reactions with Schlippe's Salt.**—A solution of Schlippe's salt mixed with an equal bulk of ammonia, and added to the solutions of the Pt metals gave the following reactions:—

$\text{Ru}_2\text{Cl}_3$  by boiling, a blackish precipitate.

$\text{RuCl}_2$ —When the solution containing the bichloride of ruthenium is boiled, and a single drop of solution of Schlippe's salt is added, a yellow transparent liquid is obtained. A larger addition gives an abundant light brick-coloured precipitate. When this larger quantity of solution of Schlippe's salt is added a slight warming is sufficient to throw down the precipitate.

$\text{Ir}_2\text{Cl}_3$ —A similar precipitate is obtained, but only after some minutes' boiling.

$\text{IrCl}_2$  is instantly decolourised by solution of Schlippe's salt with ammonia, and when boiled remains clear for a few minutes then lets fall an abundant brick brown precipitate. In this it is distinguished from  $\text{RuCl}_2$ , which lets fall the precipitate by a slight warming.

$\text{PdCl}_2$ —As ammonia precipitates palladium at once, the following course was adopted. Ammonia was placed in a test-tube, and a little palladium solution added. Heat was applied till the precipitate which at first formed was redissolved. An addition of Schlippe's salt then produced an instantaneous and abundant brown black precipitate.

$\text{PtCl}_2$  treated with Schlippe's salt, without ammonia, gave an immediate dark brick brown precipitate in the cold.

$\text{KOOsO}_3$ —Osmite of potash, dissolved in dilute caustic potash, gives with the aid of heat an immediate black precipitate with Schlippe's salt.

The following substances gave no characteristic reactions with the platinum metals:—Fulminate of ammonia, nitro-prusside of sodium, picrate of ammonia, nitrosalicylate of potash, purpurate of ammonia, benzoic acid, chloranilate of ammonia.

The new reactions which I have described in this paper include characteristic criteria for all those cases in which it has been considered most difficult to discriminate. Platinum and rhodium offer no difficulties. The first can always be recognised with ease by its behaviour with chloride of potassium, and the latter by its behaviour with caustic alkalies. For the other metals I propose here very briefly to recapitulate what I consider the chief points of interest here developed.

$\text{Ru}_2\text{Cl}_3$ —The characteristic reaction of sesquichloride of ruthenium is its beautiful colouration when boiled with hyposulphite of soda. See section third.

$\text{RuCl}_2$ —Bichloride of ruthenium is recognised by its rose-coloured precipitate with ammonio-chloride of zinc, as described in section seventh.

$\text{Ir}_2\text{Cl}_3$  } Iridium is best detected by its behaviour with  
 $\text{IrCl}_2$  } protochloride of tin and potash. The details and mode of application have been already described in section sixth.

$\text{PdCl}_2$ —The reaction of protochloride of palladium with tetrathionic acid is highly characteristic, and cannot well be confounded with any other. See section fourth.

For ascertaining the purity of solutions of iridium, particularly as respects ruthenium, the hyposulphite of soda is especially valuable, as described at the end of section third.

*Analysis of the Water of Llandudno, North Wales, by Dr. SHERIDAN MUSPRATT, M.D. (Hon.), F.R.S. Ed., &c., Founder and Principal of the College of Chemistry, Liverpool.*

LLANDUDNO having become of late years one of the most celebrated places of resort for the invalid or valetudinarian, some curt details relative to it may not prove uninteresting to your readers. The town is built under the shelter of the Great Orme's Head, encircling which vast structure a walk has been completed (distance round about five miles) affording peculiarly magnificent marine prospects; the inland views include the Vale of Conway and the majestic line of the Carnarvonshire hills. The cliffs of this immense headland are very steep, and are hollowed into caverns by the action of the sea; its sides form a range of mural precipices, and the summit a table-land. The rock is carboniferous limestone. Fossils are abundant, and the masses of petrification of sand, shells, fishes, &c., are evidence of the crag having been elevated by means of eruptions from the action of internal forces. There is embedded, in the centre of this huge mountain, copper ore. Cupriferous mines are about half a mile from the springs, and the water has been drawn from these 100 yards below.

A matter of the utmost importance to be considered in estimating the salubrity of a climate consists in its water. Llandudno is furnished with this essential to life from the west side of the Great Orme; and last summer a spring on the east lateral was added. The supply is constant, but of course fluctuates. There is a great deal more water in winter than in summer. It is brought to the town in iron conduits by its own pressure (no machinery). The date of its introduction was March 31, 1858. Previous to this the inhabitants were supplied from different springs, and some carried water from the sources that now flow into the town.

The water is excellent, as will be seen from the subjoined analysis just completed. Its inorganic constituents consist principally of chalk and common salt, both of which are tonic and stimulating, and act, therefore, beneficially:—

	Grains in the Imperial Gallon.
Carbonate of lime, $\text{CaOCO}_2$	7.329
Carbonate of magnesia, $\text{MgOCO}_2$	0.336
Carbonate of soda, $\text{NaOCO}_2$	1.310
Carbonate of iron, $\text{FeOCO}_2$	0.176
Sulphate of lime, $\text{CaOSO}_3$	2.448
Chloride of sodium, $\text{NaCl}$	3.508
Chloride of magnesium, $\text{MgCl}$	2.550
Silicate of soda, $\text{NaOSiO}_2$	0.620
Nitrate of soda	traces.

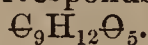


It is singular that a portion of the residue submitted to the spectroscope, gave no indications of any of the rare metals. The iron found no doubt arises in part (if not wholly) from the pipes through which the water passes. The presence of a *nitrate* in this water is somewhat significant.

#### *Researches on Picrotoxine, by M. L. BARTH.*

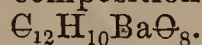
THE poisonous substance picrotoxine is remarkable from the fact that it contains no nitrogen. To the already known properties of this matter the author adds its solubility in heated fatty matters.\* Its solution in alkalis turns to the left the plane of polarisation of light.

Cocculus Indicus contains besides picrotoxine another substance, distinguished by its slightly acid properties; this acid, which may probably be the menispermic acid of Boullay, is little soluble in water, alcohol, and ether, but considerably so in soda, whence acids precipitate it in a crystalline state. This acid is free from nitrogen, and in composition corresponds to the crude formula

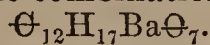


The author believes that the formula  $C_{12}H_{14}O_5$ , may be ascribed to picrotoxine itself. This formula cannot be controlled, as picrotoxine forms no definite combinations.

When an alkaline solution of picrotoxine is boiled, a modification takes place in the same way as when in presence of acids. By operating in presence of sulphuric acid, and then saturating with carbonate of baryta, the filtered liquid leaves on evaporation a syrupy mass containing a barytic compound soluble in water and in alcohol; the latter solution on evaporation leaves a brilliant varnish. The composition of this compound is



If the boiling is prolonged for thirty hours the composition of the barytic combination changes to



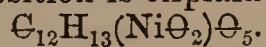
The barytic compound, when isolated, forms a gummy mass, soluble in water and alcohol, the solutions having an acid reaction. Dried at  $130^\circ$  this matter presents the composition  $C_{12}H_{16}O_6$ ; it thus represents picrotoxine plus a molecule of water,  $H_2O$ .

Picrotoxine treated by an excess of bromine gives a mass soluble in alcohol, from which it deposits as a soft crystalline mass.

The alcoholic solution of this body is precipitated by water, it is a product of the substitution of picrotoxine; its composition is,—



**Nitropicrotoxine.**—Nitropicrotoxine is prepared like nitromannite; water precipitates it from the acid liquid, in the form of a flaky mass, soluble in alcohol, whence it is deposited in small needles. Nitropicrotoxine does not detonate with heat, but it decomposes at  $100^\circ$ . Its composition is explained by the formula



The author has vainly endeavoured to analyse picrotoxine; he thinks it may be regarded as a species of sugar, indeed, it reduces alkaline solutions of copper, fixes water by prolonged boiling with acids, and gives oxalic acid when treated by nitric acid. Heated with caustic lime it gives an oleaginous liquid, in odour resembling metacetone.

The author has endeavoured to make hydriodic acid react on picrotoxine, but only obtained some products which were very difficult to purify, and in quantities too small to admit of their being studied.

\* This a well-known fact.

He also tried to produce an acid analogous to that derived from sugar of milk, by means of bromine and treatment by oxide of silver; the result was a small quantity of an acid amorphous body, soluble in water, with a flavour both acid and bitter, precipitable by subacetate of lead, and forming with lime a crystallisable salt.—*Bulletin de la Société Chimique.*

#### *Analysis of Milk,\* by MM. E. MILLON and A. COMMAILLE.*

**Method of Analysis.**—It is impossible to doubt the necessity of adding a given volume of water to milk about to be analysed, since, without this precaution, the separation of the albuminoid matters becomes a tedious, difficult, and often impracticable operation. Measure twenty cubic centimetres of milk, dilute with four volumes of water, then add five or six drops of acetic acid. Shake, to effect a complete mixture, and a coagulum will immediately form, floating freely in the mass of the liquid. This coagulum gives butter and caseine.

The liquid gives albumen, lactoproteine, sugar of milk, and salts.

Throw the coagulum on a filter, and set it on one side the liquid which passes rapidly from it.

Wash the coagulum three or four times on the same filter, with as little water as possible, as too much water would dissolve traces of caseine. After distilled water use water and alcohol, and throw away the whole of the washings. The alcohol and water make the coagulum contract, so that it can be removed from the extended filter without the least loss.

**Analysis of the Coagulum.—Butter and Caseine.**—Detach the coagulum from the filter, and press between blotting paper, then distribute it in anhydrous alcohol; throw the whole on a filter, replace the liquid which runs through by ether, to which has been added one-tenth of absolute alcohol, and continue the washing with this mixture so long as any fatty matter is carried through. The fatty matter is all removed when the ethereal liquid which creeps up the tube of the funnel evaporates without leaving the least trace of grease. The addition of alcohol to the ether is for the purpose of impeding the too rapid flow of this liquid, and consequently prolonging its contact with the caseum.

**Butter.**—Mix the alcoholic and ethereal liquids in a weighed glass capsule, drive off the liquid by heating in a water bath, and weigh the butter.

**Caseine.**—The residue, undissolved by anhydrous alcohol and ether, is entirely composed of the caseine contained in the twenty cubic centimetres of milk coagulated by acetic acid; the rapid evaporation leaves after a few minutes purely white, dry, pulverulent caseine, which may be weighed without the least difficulty.

In cow's milk we have observed very little difference in the weight of caseine, notwithstanding differences in race and feeding, the weight of this substance having varied only 33.50 gr. to 36.83 gr. per litre.

Caseine is doubtless the least variable principle in the composition of milk, and this fact is of importance when we consider how difficult it would be to imitate the properties of this matter, and to replace it by some spurious addition.

**Whey. — Albumen, Lactoproteine, Sugar of Milk, Ashes.**—Divide the whey, separated by filtering, from the coagulum into three portions—one serves to

\* *Comptes Rendus*, lix., 396. 64.



determine the albumen and the lactoproteine, another the sugar of milk, and a third the ashes.

**Albumen.**—Take 35 to 40 cubic centimetres of diluted whey, boil the liquid in a small glass flask, shaking it constantly, so as to prevent the albuminous coagulum produced by the heat from adhering to the sides. When the liquid boils throw it on a filter and wash the coagulated albumen first with water, then with alcohol, and finally with ether; spread out the filter, and the coagulum may then be removed in one piece; place it in a weighed watch-glass, and dry it at  $100^{\circ}$  C.

By operating as above, we found that cow's milk contains on an average 5 gr. 25 of albumen per litre; goat's milk, 6.43 gr.; ass's milk, 11.83 gr.; and human milk, 10.88 gr.

**Lactoproteine.**—Return the whey, boiled and separated from the albumen, to the washings of the same operation; pour into this liquid two or three drops of mercuric nitrate very carefully prepared. The proteic matter will combine with 1 equivalent of oxide of mercury  $\text{HgO}$ , forming a precipitate which will re-dissolve in an excess of the mercurial salt, or even nitric acid. Collect this compound, wash it once with water acidulated with a hundredth of nitric acid, then with pure water as long as sulphuretted hydrogen produces a colouration, then again with alcohol, and finally with a little ether. The product then dries very easily, after which weigh it, and deduct 20 per cent. for the oxide of mercury, the rest gives the weight of the lactoproteine.

**Sugar of Milk.**—In the second portion of the whey estimate the sugar of milk by M. Barreswil's process. This method is so well known that a description of it is needless.

To determine the value of the cupro-potassic liquor we very carefully prepared and purified sugar of milk; we express its reducing power by 137.5, a number deduced from numerous trials. We found, in fact, that 137.5 of sugar of milk reduces exactly the same volume of Barreswil's liquid as 100 of cane sugar.

From six analyses of cow's milk we deduced an average of 44.24 gr. of sugar of milk per litre, the difference in the extremes being from 41.64 gr. to 48.46 gr.

**Ashes.**—The volume of the third portion of the whey should be about 25 cubic centimetres; evaporate it in a weighed platinum capsule over a naked fire for three-quarters of the liquid, and finish the evaporation in a water bath. When, after two successive weighings, the weight of the residue no longer varies, ignite it over a spirit-lamp, and the ashes will be obtained under these conditions without any difficulty. We endeavoured to ascertain whether caseine and butter take with them any considerable quantity of saline matter, and found that their combustion did not leave an appreciable quantity of ash.

The residue of the evaporation of whey contains before incineration, besides albumen, lactoproteine, sugar of milk, and ashes, various organic acids, the weight of which may be estimated by difference, though all the coexisting principles have been determined by a special operation; we have not tried to estimate them in any other way.

**Odour of Milk.**—Shaking new milk with three or four volumes of pure sulphide of carbon gave a curious result; on the liquid being allowed to stand the sulphide separates, without dissolving the butter, but charged with an aromatic matter. And by allowing it to evaporate spontaneously, an unctuous residue remains, almost imponderable, and possessing a high degree of the aroma contained in the food of the animal producing

the milk. Generally, this is the fragrant odour of fodder, but sometimes also the odour is disagreeable, owing to the ingestion of nauseous-smelling plants, and sometimes it is rancid, from the decomposition of the food.

Cow's milk only has this peculiarity; that of the goat, for instance, gives no means of discovering the nature of the food; the slight residue left when this milk is treated with sulphide of carbon being perfectly inodorous—at least, we have hitherto found this to be invariably the case.

**Colour of Milk.**—Another characteristic of cow's milk is shown when the separation of butter is effected in the galactometer; the fatty matter which, in the assay tube, floats on the surface of the liquid, is always of a yellow colour; we have found no exception to this, which may, however, depend upon the mode of feeding; but from goat's, sheep's, woman's, and ass's milk we have not less invariably isolated a perfectly colourless butter.

#### *Action of Alkaline Hyposulphites on Chromates of Potash and Ammonia, by M. E. KOPP.*

ALKALINE hyposulphites in presence of chromates render very evident the difference of oxidising energy between bichromates and neutral chromates. While the first, especially if assisted by heat, react immediately on the hyposulphite, the latter remain for almost any length of time in contact with this salt without any alteration taking place either in the chromate or the hyposulphite. Hence we may predicate the result of mixing solutions of potassico-ammonic chromate and hyposulphite of soda.

When cold nothing happens, the liquid remains yellow; even on boiling there is at first no sign of decomposition; but gradually, as the ammonia is disengaged, and the neutral chromate changes to bichromate, the reaction begins, the liquid becomes cloudy, and leaves a more or less abundant deposit of chromic superoxide, varying in tint from brownish-yellow to very dark brown, according to the concentration of the liquids and the duration of the boiling.

The following experiments show this mode of decomposition.

In four flasks dissolve in 500 cubic centimetres of distilled water the following mixtures, and boil them for three hours without replacing the evaporating water:—

- (a) 10 gr.  $\text{Cr}_2\text{O}_6$ . KO and 8 gr. 21  $\text{S}_2\text{O}_2\text{NaO} + 5$  aq.
- (b) 10  $\text{Cr}_2\text{O}_6$ . KO + 8.21  $\text{S}_2\text{O}_2\text{NaO} + 5$  aq. + excess of ammonia.
- (c) 10  $\text{Cr}_2\text{O}_6$ . KO + 8.21  $\text{S}_2\text{O}_2\text{NaO}$  5 aq. + 5.25 sal ammoniac + excess of ammonia.
- (d) 10  $\text{Cr}_2\text{O}_6$ . KO + 8.21  $\text{S}_2\text{O}_2\text{NaO}$  5 aq. + 5.24 sal ammoniac.

The following phenomena were observed:—

(a) As soon as the salts were dissolved by the addition of hot water the solution became darker and darker, passing from orange to yellowish brown. Then the liquid became cloudy, a dark cinnamon-brown precipitate formed, becoming more abundant as the boiling proceeded.

However, at the end of the experiment, by collecting the precipitate on a filter and washing it rapidly with cold water, it was found that the mother liquors were still strongly coloured yellow, and contained a notable portion of neutral potassic or sodic chromate.

(d) Behaved like a, except that the mother liquor was barely coloured yellow, and that the precipitate was a little lighter. The more complete decomposition of the chromic acid was evidently produced by the addition of ammoniacal salt, and the mixture might then be con-



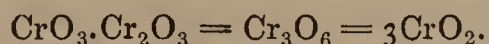
sidered as formed of chloride of potassium and ammonic bichromate, and nearly all the ammonia disengaging itself on boiling, the hyposulphite of soda was free to react on nearly all the chromic acid present.

(b) A yellow and limpid solution remaining unchanged, even after the commencement of ebullition; but as the ammonia was disengaged the liquid became disturbed, and formed a dark cinnamon-brown precipitate. On filtering the liquid was still of a brownish-orange colour, and on reboiling gave a certain quantity of precipitate. The mother liquors indicated only the yellow colour of neutral chromate.

(c) Behaved like b, only the precipitate was of a darker shade, and the mother liquors contained but traces of the undecomposed chromate.

On mixing the mother liquors of the four operations, and boiling them again for a long time, a fresh quantity of yellowish brown precipitate was obtained, rather lighter in colour than the others.

These precipitates may be considered as formed of chromic superoxide,  $\text{CrO}_2$ , or chromic chromate,



In fact, they easily divide into chromic acid and oxide of chromium. We have been able to verify the correctness of the observation of MM. Elliot and Storer (*Répertoire de Chimie Appliquée*, 1861, p. 390), that by washing with water, especially with boiling water, the chromic superoxide constantly loses chromic acid, which dissolves, and the residue on the filter becomes richer and richer in oxide of chromium.

By boiling with caustic or carbonated alkalies,  $\text{CrO}_2$  separates almost immediately into greenish insoluble hydrate of oxide of chromium and soluble alkaline chromate. This property may be utilised in making its analysis. Chromic superoxide may be put in contact with cold diluted acids without being dissolved or altered. The filtered acid liquid contains a small quantity of chromic acid and is generally yellow, while the precipitate is darker.

Hot hydrochloric acid easily dissolves it with production of a brown colour, and disengagement of chlorine; on evaporation there remains a green solution of chromic chloride.

When calcined, chromic superoxide, prepared by the action of hyposulphite of soda, disengages water and oxygen and leaves a dark, muddy, green residue of oxide of chromium.

**Analysis of Chromic Superoxide.**—The precipitates of the above operations washed as quickly as possible in tepid water (which constantly removed chromic acid) were placed on sheets of paper to drain, then wrapped in paper, and so left for about ten days to dry in the sun.

Qualitative analysis having shown the presence of small quantities of sulphuric acid in the precipitate, 5 gr. of it were dissolved in boiling hydrochloric acid, and the diluted solution was precipitated by chloride of barium. We obtained,—

For (a) 0 gr. 2040  $\text{SO}_3$  BaO corresponding to 0 gr. 07  $\text{SO}_3$  = 1.40 p. 100  $\text{SO}_3$ .

For (b) 0 gr. 2695  $\text{SO}_3$  BaO corresponding to 0 gr. 0925  $\text{SO}_3$  = 1.88 p. 100  $\text{SO}_3$ .

For (c) 0 gr. 1345  $\text{SO}_3$  BaO corresponding to 0 gr. 046  $\text{SO}_3$  = 0.92 p. 100  $\text{SO}_3$ .

For (d) 0 gr. 1825  $\text{SO}_3$  BaO corresponding to 0 gr. 0625  $\text{SO}_3$  = 1.25 p. 100  $\text{SO}_3$ .

After the excess of barytic chloride has been precipitated by a few drops of sulphuric acid, the filtered

solution serves to estimate the quantities of oxide of chromium in the compound.

To estimate chromic acid one gramme of superoxide is dissolved in pure hot nitric acid; after sodic acetate and water are added to the solution, a mixture of sulphate and chromate of lead is precipitated by acetate of lead, and dried and weighed, and from it is deducted the sulphate of lead calculated according to the proportion of sulphuric acid already determined.

Capable of  
losing by  
calcination.  
Oxygen.

(a) furnishes	0 gr. 364 of $\text{CrO}_3\text{PbO}$	= 11.30 per c. $\text{CrO}_3$	2.70
(b) „	0 gr. 3365 „	= 10.45 „	2.50
(c) „	0 gr. 3930 „	= 12.20 „	2.91
(d) „	0 gr. 3720 „	= 11.55 „	2.76

Then calcine a certain quantity of each of these precipitates at dull red heat in a platinum crucible, and the losses will be as follows:—

Water and Oxygen.

1.890 gr. of (a)	will lose 0 gr. 650 = 34.39 per cent.
1.238 gr. of (b)	„ 0 gr. 450 = 36.35 „
2.451 gr. of (c)	„ 0 gr. 858 = 35.00 „
2.310 gr. of (d)	„ 0 gr. 797 = 34.50 „

These data give to the different precipitates the following composition:—

	a	b	c	d
Sulphuric acid.	1.40	1.85	0.92	1.25
Chromic acid.	11.30	10.45	12.20	11.55
Oxide of chromium.	55.51	53.85	54.79	55.46
Water	31.79	33.85	32.09	31.74
	100.00	100.00	100.00	100.00

These figures correspond to no formula.

Having observed that the precipitate formed in the liquid changed colour under prolonged boiling, some potassico-ammonic chromate was re-boiled to which ammonic chloride and a small quantity of sodic hyposulphite had been added. As soon as brownish yellow precipitate formed it was collected on a cloth filter, washed once with cold water, strongly pressed between folds of blotting-paper, and then dried in a water bath.

2 gr. dissolved in nitric acid furnish 1.762  $\text{CrO}_3\text{PbO}$  equivalent to 0 gr. 546  $\text{CrO}_3$  or 27.31  $\text{CrO}_3$ , capable of losing 6.52 of oxygen by calcination.

The same precipitate lost 37 per. cent of its weight by calcination.

The composition, then, corresponds approximatively to the formula  $\text{CrO}_2 + 2 \text{aq}$ . The result being

	Calculation.	Experiment.
$\text{Cr} = 328 = 43.56$		
$\text{O}_2 = 200 = 26.56$		
$2\text{HO} = 225 = 29.98$		
	100.00	100.00
or, rather		
Chromic acid.	27.31	27.31
Chromic oxide	42.21	42.21
Water	30.48	30.48
	100.00	100.00

After adding an excess of sodic hyposulphite to the mother waters, boil for an hour, and collect the yellowish-brown precipitate (1). After prolonged re-boiling, a new precipitate forms (2) of a darker colour; then filter, and after again boiling a third precipitate forms, but of a bluish-grey colour, containing no chromic acid, but only hydrated oxide of chromium, contaminated with a little sulphuric acid and sulphur; the mother liquors become quite colourless.

Precipitates (1) and (2), after careful washing, were dried in the air and analysed; they contained but a trace of sulphuric acid, of which no notice was taken.



2 gr. of (1) furnished 0.852 of  $\text{CrO}_3\text{PbO} = 13.56$  per cent.  $\text{CrO}_3$ , being able to lose 3.24 of oxygen.

1 gr. 903 calcined lost 0.727;  $\text{HO} + \text{oxygen} = 38.20$  per cent.

1.2 gr. of (2) furnished 0.332  $\text{CrO}_3\text{PbO} = 8.812$  per cent.,  $\text{CrO}_3$  losing 2.105 of oxygen.

2 gr. 350 calcined lost 0.860 = 36.60 per cent.

These figures indicate the following composition. For the first precipitate (1):—

Water . . . 34.96	or, rather	Water . . . 34.96
Chromic acid . 13.56		Chromium . 42.41
Oxide of chromium . . 51.48		Oxygen . . 22.63
100.00		100.00

or, rather	Water . . . 34.96
	Oxygen . . . 3.24
	Oxide of chromium . . 61.80
	100.00

These numbers correspond best with the formula  $2\text{CrO}_3 + 5\text{Cr}_2\text{O}_3 + 28 \text{ aq.}$  In fact,

$$\begin{array}{rcl} 2\text{CrO}_3 & = & 1256 = 13.67 \\ 5\text{Cr}_2\text{O}_3 & = & 4780 = 52.04 \\ 28\text{HO} & = & 3150 = 34.29 \\ \hline & & 9186 \quad 100.000 \end{array}$$

For the second precipitate (2):—

Water . . . 34.495	or, rather	Water . . . 34.495
Chromic acid . 8.812		Oxygen . . . 2.105
Oxide of chromium . . 56.693		Oxide of chromium . . 63.400
100.000		100.00

or, better	Water . . . 34.495
	Oxygen . . . 22.000
	Chromium . . 43.505
	100.000

$$\begin{array}{rcl} \text{CrO}_3 & = & 628 = 9.22 \\ 4\text{Cr}_2\text{O}_3 & = & 3824 = 56.12 \\ 21\text{HO} & = & 2362 = 34.66 \\ \hline & & 6814 \quad 100.00 \end{array}$$

These numbers may be approximately represented by formula  $\text{CrO} + \text{HCr}_2\text{O}_3 + 21\text{HO}$ .

In fact,

The result of all these data is that the compound  $\text{CrO}_2 + 2 \text{ aq.} = \text{Cr}_2\text{O}_4 + 4 \text{ aq.}$ , by losing chromic acid at last gives hydrated oxide of chromium, having for formula  $\text{Cr}_2\text{O}_3 + 4 \text{ aq.}$ , and containing 32 per cent. of water of hydration.

If we have rather prolonged the analysis of the brown-yellow precipitate obtained under the circumstances described, though the compound is so liable to alteration and undergoes modification by simple washing in water, it is that we might give a better account of the nature of the body decomposed on the fibres of paper and cloth consequent on the reduction of chromic acid.

It remains for us to say a few words on the phenomena which takes place when, besides the reducing hyposulphite, there is associated with the potassico-ammonic chromate another salt, the acid of which will combine with oxide of chromium.

If, instead of making alkaline hyposulphite react alone on potassico-ammonic chromate, we at the same time add a certain quantity of another salt, with an energetic acid capable of forming an insoluble salt, with oxide of

chromium, it is no longer chromic superoxide, but a salt which is precipitated.

Having boiled a solution of 10 gr. potassico-ammonic chromate, 10 gr. crystallised hyposulphite of soda, 10 gr. crystallised phosphate of soda in one litre of water, reduction is gradually effected, and a pulverulent precipitate of a pretty green colour is formed (rather similar to Schweinfurth green much mixed with white).

By replacing the phosphate of soda by sodic arseniate, the precipitate was pulverulent, of a darker green, but at the same time more greyish.

By using yellow prussiate, the precipitate was light green pulverulent.

By using red prussiate the precipitate became olive green, gelatinous, and difficult to wash.

Similar results were obtained by adding ammoniacal salt to these solutions.

It is reasonable to suppose that these results may be applied to calico printing.

The following is the result of some experiments made for this purpose:—

Potassico-ammonic chromate, either alone or with the addition of ammoniacal salt, or what comes to the same thing, bichromate of potash dissolved in liquid ammonia (avoiding any excess), was dissolved in gum-water, and an equal weight of hyposulphite of soda was added.

The colour remains unchanged, even in the air, for almost any length of time.

By printing it on calico, and letting it dry slowly, it takes a warm, rich, cinnamon-brown tint.

By steaming and washing the tint becomes olive. It is then a true chrome mordant, for it may be washed and dyed with madder, dye-wood, &c.

It is to be regretted that the cinnamon-brown colour undergoes alteration by prolonged washing, by the action of water, soap, alkalies, since a very beautiful tint can be produced.

By adding phosphates, arseniates, alkaline prussiates to the colour, the designs likewise take a brown tint on drying; but if steamed this tint gives way to green tints, more or less dark or olive, according to the nature of the salt added.

These colours possess a fair degree of stability, and as green colours some of them are no doubt fit for various applications.

It is probable that the red prussiate green, with base of oxide of chromium (chromic ferricyanide) is uncertain when employed in large quantities, may be replaced by the vapour green prepared by the action of alkaline hyposulphites on ammoniacal chromate, in presence of red prussiate of potash.

One drawback to these chromate and hyposulphite colours is that they cannot be thickened with starch, for in a short time the mixed colour coagulates strongly. By thickening it with gum we have hardly ever observed any coagulation.

**Action of Phosphorus on Potassic Bichromate, and on Potassico-ammonic Chromate.**—By leaving a solution of these salts in presence of a rod of phosphorus during the summer, exposed to the direct rays of the sun, or by favouring the reaction by means of heat, a reducing reaction is quickly established, and in a few days the liquid contains only neutral chromate of potash and a light green precipitate. This is well washed and dried in the air.

It contains a considerable quantity of phosphoric acid. Indeed, after calcining it in a platinum crucible with an excess of carbonate of soda, dissolving in water, filtering, neutralising by hydrochloric acid, a few drops of the



liquid are sufficient to produce in an ammoniacal solution of a salt of magnesia, a crystalline precipitate abounding in ammoniaco-magnesian phosphate.

This fact shows that after purifying phosphorus by a solution of bichromate of potash, it is not necessary to prolong the contact between these two bodies, or to avoid the influence of the direct rays of the sun.—*Moniteur Scientifique*.

#### *Constant Battery to be Applied to the Manufacture of Magnesium, by ARTHUR REYNOLDS, B.Sc.*

It has occurred to me that a constant and cheap battery might be made, by employing for an exciting liquid a solution of perchloride of iron, and for the metal to be attacked, metallic iron, the copper plate being replaced by carbon.

The most convenient form of the battery would be to have pots made of carbon for holding the liquid. Slits cut in a thick plate of gas retort carbon would do. The action of the battery would be quite constant, as the exciting liquid would always remain in the same condition, the iron dissolving by reducing the solution to protochloride, which being oxidised by the air would be deposited, so that the solution would always remain of the same strength.

This would be as cheap, or cheaper than any other form of battery, and perpetually constant, and the same acid would do for a long time.

The purpose for which I propose to employ the battery is, to the manufacture of magnesium from sea-water. The sea-water should be evaporated with a little chloride of calcium, and after the main bulk of the common salt and sulphate of lime has crystallised out, the solution should be evaporated to dryness, the dry mass melted, and decomposed by the voltaic battery before described. This process would be sure to succeed.

### TECHNICAL CHEMISTRY.

#### *A New Blasting Gunpowder, by M. H. SCHWARTZ.*

THIS powder is now largely employed in mining. Its combustion is slow, but complete. The following analyses show why it is cheaper than ordinary powder:—

	I.	II.
Soluble salts .	74.55	74.32
Nitrate of potash .	56.22	56.23
Nitrate of soda .	18.30	18.09

The treatment by sulphide of carbon produced,—

Dissolved sulphur .	9.68	7.61
Carbon remaining .	14.14	15.01
Moisture .	1.78	1.1

It is a coarse-grained powder, in which one part of potash nitre is replaced by nitrate of soda.

In the first instance, one part of nitrate of soda for one part of nitrate of potash was used, but it was afterwards found best to employ "a third of nitrate of soda.—*Bulletin de la Société Chimique*.

#### *The Employment of Sulphide of Lead as a Decolorising Agent, by M. GRAEGER.*

THE use of animal charcoal for the decolorisation of solutions of vegetable acids presents frequent difficulties on account of the solubility of phosphate of lime. The author has therefore endeavoured to replace animal black by other matters, and has found that sulphide of

lead can be very advantageously employed in the manufacture of tartaric acid. When solutions of tartaric acid are decolorised with bone black, the first crystallisation generally gives colourless crystals, while those from the mother liquor are covered with a white coating of tartrate of lime, and have to be redissolved with the addition of sulphuric acid to the liquid. The employment of sulphide of lead necessitates some simple precautions. The sulphide should be perfectly free from sulphate, which is soluble in tartaric acid; it must consequently be prepared in the presence of an excess of alkaline sulphide. The author decomposes acetate of lead by sulphide of sodium. It is not sufficient that the supernatant liquid should be free from lead, as there might in that case remain some sulphate of lead, produced by oxidation of sulphide, in the precipitate, but there must be an excess of alkaline sulphide.\* Though there is a slight disengagement of hydrosulphuric acid during the boiling of solutions of tartaric acid with sulphide of lead, the author has ascertained that the liquids remain free from this metal. Solutions thus decolorised always give colourless and transparent crystals.—*Bulletin de la Société Chimique*.

### PROCEEDINGS OF SOCIETIES.

#### PHARMACEUTICAL MEETING.

Wednesday, January 4.

Mr. SANDFORD, President, in the Chair.

THE first paper read was by Dr. ATTFIELD, and entitled "Notes on Perchloride of Iron and its Pharmaceutical Preparation," a report of which is deferred until next week.

The next paper was by Mr. BALMANNO SQUIRE, "On a New Form of Ointment of Stavesacre, and its Application in certain Skin Diseases." Mr. Squire believes that the intractable skin disease known as prurigo senilis is the consequence of the presence of the common louse, *pediculus corporis*, and that the best thing for getting rid of the parasite and curing the disorder is an ointment of stavesacre. But stavesacre seeds contain a good deal of oil, and are difficult to powder, and ointment made from the crushed seeds is an inconvenient and inelegant preparation. Dr. Squire has found, however, that the oil expressed from the seeds contains all the active properties, and when mixed with lard and a little white wax, to give consistence, it makes an excellent and useful ointment. A preparation nearly as effective, but not so white, can be made by digesting the crushed seeds in hot lard for some hours, and then straining. This ointment, though not so good as the former, is very useful for itch.

Professor BENTLEY then announced an interesting discovery lately made by Dr. Daniell. It was the presence of theine in the kola nut, the fruit of the kola or *sterculia acuminata*, an article used extensively as food by the natives of Central Africa. This, the Professor said, was a very important discovery, since it added one more order of plants to those already known to contain the alkaloid. But, since the kola belongs to the same, or an order very closely allied to that which included the cocoa, he thought the alkaloid might perhaps be found to be theobromine.

Dr. ATTFIELD showed on a watch-glass some of the alkaloid which he had extracted from the nuts, forwarded by Dr. Daniell. The crystals resembled so exactly those of some theine extracted from tea, for the sake of comparison, that the Doctor said he had no doubt the alkaloid was theine, and not theobromine.

\* The acetate of lead may be replaced by sulphate, which is found as a waste product in print works, and is very cheap. But the use of sulphide of lead for the decolorisation of tartaric acid seems not to be without difficulties, as by contact with the air this body oxidises, and is transformed into sulphate. To avoid this, it must always be used directly it is prepared.



It was announced that, at the next Pharmaceutical meeting, a paper, by Dr. Daniell, on the subject would be read, and also a paper, by Dr. Attfield, on the analysis of the nuts.

The next paper was "*On the Purification of the Essential Oil of Bitter Almonds*," by Mr. W. A. TILDEN. Of the processes hitherto in use for separating prussic acid from oil of bitter almonds, no one is quite efficient and satisfactory, and the author's object was to find a method free from the objections brought against those commonly employed. One process proposed was founded upon the splitting up of hydrocyanic acid into formic acid and ammonia with the assistance of the elements of water. This change is effected by the intervention of a strong mineral acid. But in the presence of hydride of benzoyl formic acid is not set at liberty, but it unites with the elements of the hydride to form a conjugate acid—formo-benzoylic acid. The formation of this acid necessarily involves a loss, which is sometimes considerable. Mr. Tilden's object was to devise a process for the destruction of the hydrocyanic acid, which would not involve the production of the formo-benzoylic acid, and so avoid the loss mentioned. In this he had succeeded, to a certain extent, by following the method now described. The crude oil was mixed in a flask with three times its bulk of hydrochloric acid a little diluted, and then distilled. As soon as the oil began to pass freely more water was added, and the distillation proceeded with. A mixed distillate of oil and acid water was obtained, from which the oil was separated and rendered neutral by means of quicklime. Hydrate of lime must not be used, since it discolours the oil. Theoretically 8 per cent. of hydrocyanic acid in the oil would in this process occasion a loss of 31.4 per cent. of the hydride, and 5 per cent. of hydrocyanic acid would cause the removal of 19.6 per cent. of hydride. The author, however, has made two quantitative experiments, and believes that on the large scale the average loss would not exceed 17 per cent., which loss would include the hydrocyanic and benzoic acids, and other impurities. Another and better process had been suggested to the author by Mr. Broughton, who had thought that, since the hydride of benzoyl is to be regarded chemically as the aldehyde of the benzoyl series, it could be freed from its impurities by taking advantage of the general property possessed by all aldehydes of forming a definite crystalline compound with an alkaline bisulphite. The plan succeeded perfectly. The crude essential oil is to be shaken with an equal volume of a strong solution of bisulphite of soda. The mixture becomes warm, and the essential oil is all converted into a crystalline mass. This is drained, dried, then dissolved in a small quantity of water, and distilled with carbonate of soda.\* In this process no loss is experienced beyond the impurities, and the hydride is obtained absolutely pure. To preserve it so it is essential that it should be perfectly dry, and it is advisable to rectify with chloride of calcium. The pure hydride oxidises to benzoic acid with great facility, and the oxidation is more rapid in the presence of moisture. The crude essential oil was much more permanent, the reason for which was not perfectly known.

Dr. REDWOOD said that he had worked upon the same subject, but had never obtained completely satisfactory results. It was easy to remove the prussic acid by means of oxide of mercury, but it was an object to avoid loss, and also to ensure the permanency of the pure oil. Dehydrating the oil was successful to some extent, but the oil was never used unless diluted with spirit which contained some water, and this favoured rapid oxidation, by which the solution lost much of its flavour. As the crude oil was so much more permanent, it was advisable to try and find out some combination which would resemble the crude oil. The hydrocyanic acid in the oil was not all

present in the free state, and Liebig had shown that the whole amount was not at once precipitated by mercuric oxide. The combined hydrocyanic acid might act as the preservative agent, and perhaps an innocuous acid, like hydrochloric, would answer the same purpose.

Mr. TILDEN remarked that the hydrocyanic acid did not exist in the oil as a cyanide. It was probably furnished by benzimide.

Mr. ALLCHIN said it was important to devise some means of preserving the oil, since the spirituous solution so quickly oxidised that he had had some returned to him quite destitute of flavour. The substitution of some other radical for cyanogen would, perhaps, effect the purpose.

Mr. HASELDEN followed up some remarks of Dr. Redwood, who had observed that the paper read had been brought from the Chemical Discussion Society, which had proved a valuable auxiliary in bringing papers before the Pharmaceutical meetings. Mr. Haselden regretted the scanty attendance of the members at the meetings, for the younger members, who often took a good deal of time and trouble in preparing their papers, required and deserved more encouragement than they received.

(To be continued.)

## ACADEMY OF SCIENCES.

January 2, 1865.

M. DÉCLAT contributed a memoir "*On the Use of Phenic Acid in Medicine*." The author dwelt principally upon the action of phenic acid as a local application to sloughing wounds, on which the action of the acid appears to be most remarkable. He also mentions a case of epithelial cancer of the tongue, in which it appears to be effecting a perfect cure. As an injection in some affections of the bladder and the genito-urinary organs, it also seems to produce most beneficial effects. In obstinate eczema and other skin diseases, a lotion of the acid appears to be most useful; while as a general and local disinfectant it seems unequalled. Lastly, he mentions two cases of croup, in which the effects were most striking.

A letter from M. Berthelot, "*On Alcoholic Fermentation*," gives some striking and original views of the nature of sugar. These are derived from the consideration of the amount of heat furnished by the combustion of sugar, and also by its possible constituents. The author starts with the proposition that the bodies whose decomposition is attended with the disengagement of heat should, in his opinion, be divided into two classes: 1, those whose formation, regarded independently of all other phenomena, is attended with *positive work*, disengagement of heat; and 2, those whose formation is accompanied by *negative work*, absorption of heat. It concerns us to know to which of these classes sugars belong. The solution of this question depends upon the manner in which sugars may be formed by means of their elements, this formation being considered independently of all the other reactions which may accompany it. Glucose,  $C_{12}H_{12}O_{12} = 180$ , may, for example, be formed by the following groupings, among others, and the combustion of 180 grammes of these will give the amount of heat attached. (The unit is the amount of heat that will raise a kilogramme of water 1 degree.)

Grouping of the Elements.		Corresponding heat of Combustion.
Carbon and water,	$C_{12} + H_{12}O_{12}$	576
Carbonic acid and marsh gas,	$3C_2O_4 + 3C_2H_4$	630
Carbonic acid and alcohol,	$2C_2O_4 + 2C_4H_6O_2$	652
Carbonic oxide and hydrogen,	$6C_2O_2 + 6H_2$	804
Formic acid and hydrogen,	$6C_2H_2O_4 + 6H_2 - 6H_2O$	980

On the other hand, the author calculates from the numbers given by Dubrunfant for the heat disengaged in the

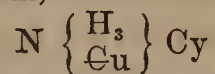
\* This process is described in "Gmelin's Handbook," vol. xii., p. 22; but we do not dispute the originality of Mr. Broughton's idea.



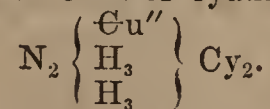
alcoholic fermentation, and those given by Favre and Silbermann for the combustion of alcohol, that the heat of the combustion of sugar should be near 726. If sugar results from the association of carbon with the elements of water, or the association of the elements of alcohol with those of carbonic acid, the alcoholic fermentation will be comparable with the destruction of oxygenated water or of formic acid. But sugar may equally be formed by the union of hydrogen with the elements of carbonic oxide or formic acid; and the latter appears the more probable, since the effect of light on the respiration of plants—the primary origin of the formation of sugars—is to decompose at once both carbonic acid and water. If this view be correct, the alcoholic fermentation will be essentially a true combustion, giving rise to carbonic acid by virtue of an internal reaction comparable to the combustion of free carbon by free oxygen. The amount of heat disengaged at the moment of the formation of carbonic acid at the expense of the carbon and oxygen combined in the sugar is equal to about two-fifths of the heat that would produce the formation of the same amount of carbonic acid at the expense of the free elements,—a result it may be useful to note in considering the theory of animal heat. However it may be, the number 726 measures (inversely) the labour expended by solar light in transforming water and carbonic acid into sugar. The difference between this total and the heat of the combustion of alcohol—that is, 74—gives approximately the measure of the work necessary to be expended in reconstituting sugar by re-uniting carbonic acid with alcohol; in other words, re-uniting the products of the alcoholic fermentation.

M. Hugo Schiff presented a note "*On the Action of Aldehyds upon Amines.*" With cœnanthic or benzoic aldehyd and amylamine, the author obtained dïcœnanthylidene-diamylamine and ditoluydene-diamylamine. The author submitted many amines to the action of aldehyds, and the general result of his researches is, that in every instance the typical hydrogen of the base is completely removed by the oxygen of the aldehyd, and replaced by the biatomic residue of the latter. In this way the aldehyds offer a new and easy means of determining the number of the equivalents of typical hydrogen. This reaction is preferable to that of hydriodic and hydrobromic ethers, because with these each equivalent of hydrogen requires a fresh treatment, while with the aldehyds one experiment suffices for all. In many cases the typical hydrogen may be determined by a simple volumetric experiment, pure cœnanthol being employed, and a burette divided into 20ths of a cubic centimetre. The cœnanthol must be added to the base, slightly heated, so long as water is eliminated.

MM. H. Schiff and E. Becchi also contributed a note "*On Ammoniacal Cyanide of Copper.*" The object of the note was to correct some mistakes of M. Lallemand; but, as we did not publish that paper, it is only necessary to give the results of the present communication. Dry cuprous cyanide absorbs dry ammonia, and a white powder, cyanide of cuprosonium,



is produced. While dry this powder does not change in the air; but if moistened with water or ammonia it becomes violet. When cuprous cyanide is boiled with ammonia in the air, oxygen is absorbed, and violet crystals are obtained, which consist of the above cyanide of cuprosonium, with a small amount of cyanide of cupriconium.



The authors are inclined to believe all the violet salts mixtures of two cyanides. A chemical compound of the above two salts gave beautiful deep green crystals, which had the composition  $\text{N}_2\text{H}_6\text{CuCy}_{2.4}\text{NH}_3\text{CuCy}$ . There was found at the same time a deep blue-coloured salt, which decomposed on being dried, losing ammonia.

## NOTICES OF BOOKS.

*Chemical, Natural, and Physical Magic, intended for the Instruction and Entertainment of Juveniles during the Holiday Vacation.* By SEPTIMUS PIESSE, Ph.D., F.C.S., &c. Longman and Co. London. 1865. Third Edition.

DR. PIESSE, writing for his own children, he says, adds, as they grow older, matter which requires more and more mental labour to understand. These additions, he trusts, will make this edition of his book more entertaining. We have our doubts about this, and are inclined to believe some of the additions neither entertaining nor instructive. There is much, however, in the book to interest and excite the attention of intelligent children, and to these it will furnish both instruction and entertainment during their "holiday vacations."

*A Manual of Diet and Regimen for Physician and Patient.* By HORACE DOBELL, M.D., &c. London: Churchill and Sons. 1864. (Second Edition.)

WE are half disposed to be as sorry for the medical man as the patient who requires this book; and yet there is no denying that to some it may be a very useful publication. A physician has often little to do beyond prescribing a patient's dinner; and it will answer his purpose very well, and amuse the patient besides, if he gets one of these little books and adopts the author's suggestions. Here is a list of all sorts of foods and drinks, and the doctor has only to write "No," "Yes," and "Yes, especially!" opposite them in order to give his patient a complete guide as to what to eat, drink, and avoid. Besides this, the author has taken a good deal of trouble to calculate a series of normal diet tables for a healthy adult man, founded upon the assumption that such a character requires daily fixed and definite proportions of certain materials to keep his machinery going. From these tables we learn that 25 ozs. of bread,  $3\frac{1}{4}$  ozs. of cheese, and 2 ozs. of butter, are very nearly the nutritive equivalents of 6 ozs. of cooked meat, poultry, or game, 4 ozs. of fish, 10 ozs. of bread, 8 ozs. of potatoes, 2 ozs. of rice,  $2\frac{1}{2}$  ozs. of sugar,  $2\frac{1}{2}$  ozs. of butter, with 5 ozs. of milk and some tea and coffee. Sixteen ounces of oatmeal, with 22 ozs. of milk, with  $1\frac{3}{4}$  ozs. of butter, and  $\frac{3}{4}$  of an ounce of sugar, have an equal value; which teaches us that we have no occasion to waste pity on people who live on bread and cheese or porridge, supposing they get enough of it.

Another table gives the alcoholic and other contents of most ordinary spirituous liquors; and the author directs them to be prescribed according to the amount of absolute alcohol the physician will allow his patient. But we believe most physicians know that the effects of these fluids are by no means measured by the amounts of alcohol they contain. A series of excellent rules for promoting and maintaining vigorous health are prefixed to the tables. They relate to clothing, sleep, exercise, meals, &c., and we are glad to find that in one the author endorses a suggestion we lately saw extracted from an American paper—viz., "If your business obliges you to go out before breakfast, have some breakfast first."

*Journal für praktische Chemie*, No. 20, 1864.

THIS number opens with an interesting paper by Deichsel on "*Mesoxalic Acid.*" The author describes the already known methods of obtaining this acid for alloxan, and then gives an account of several of its salts. He further investigated the product of the reduction of the acid by means of sodium amalgam, and found tartronic acid. Dr. A. Baeyer, in a paper "*On the Synthesis of Aceconitic Acid from Acetic Acid,*" describes two new acids obtained by treating bromacetic ether with sodium. The crude product of the action of these two bodies is a dirty brown mass, which blackens in the air. Distilled in a



vacuum above  $200^{\circ}$  C. the mass yields an ether, or rather two ethers, the mixture of which offers great resemblance to aconitic ether, but which is really the ether of two new acids, *aceconitic*,  $C_6H_8O_6$ , or  $C_3H_5.C_3H_3O_3\} O_3$  and *citra-cetic*. The salts of the latter acid will not crystallise, and the author has not yet determined the formula. Both are tribasic acids. A short note on "*Oleic Acid*," by Burg, describes some of the products of the action of bromine on that, and also on elaidinic acid. Jaffé also describes bromangelic acid. The next paper is by Professor Barfoed, of Copenhagen, "*On Sulphide of Mercury and some Basic Sulphur and Mercury Salts*." We give the author's *resumé*:—1. The black precipitate formed when a mercurous salt is treated with HS or colourless sulphide of ammonium, is not  $Hg_2S$ , but a mechanical mixture of mercury and sulphide of mercury. 2. The black precipitate, therefore, is acted on by nitric acid. By treatment therewith the mercury is oxidized as usual to mercurous or mercuric nitrate, according to circumstances, and in the latter case the whole precipitate is converted into a basic sulpho-nitrate of mercuric oxide,  $HgONO_5 + 2HgS$ , which remains undissolved, and mercuric nitrate, which dissolves. 3. The basic sulpho-nitrate, which can be formed in several ways besides the one here described, is nearly insoluble in nitric acid. By hydrochloric acid it is converted into basic sulpho-chloride, which contains more sulphide of mercury than  $HgCl + 2HgS$ , but by heating this is quite decomposed, and dissolves with separation of sulphur and the formation of sulphuric acid. By means of the strongest sulphuric acid it is converted into basic sulpho-sulphate of mercuric oxide,  $HgO,SO_3 + 2HgS$ . By sulphuric acid specific gravity 1.84, it is decomposed into mercuric sulphate with evolution of sulphurous acid. 4. Black sulphide of mercury is under ordinary circumstances insoluble in nitric acid, and not visibly attacked. But by long-continued heating it is at last converted into white basic sulpho-nitrate, and sulphuric acid which dissolves a trace of mercury. 5. The sulphide of mercury is insoluble in sulphhydrate of sulphide of sodium. Dissolved in sulphide of sodium it is again precipitated by sulphuretted hydrogen. Our readers will see that these are important facts bearing on the separation of mercury by the ordinary analytical methods, and we shall return to the paper. The last paper is by R. Weber, "*On a Compound of Chloronitrous Acid with Sulphuric Acid*." Chloronitrous acid gives with anhydrous sulphuric acid a white crystalline compound, answering to the formula  $2SO_3 + NO_2Cl$ . The dry vapours of the two are brought together in a well cooled flask. The sides of the flask soon become covered with an oily liquid, which as it gets colder solidifies into a crystalline mass, resembling in appearance stearic acid. The mass fuses without decomposing. At a higher temperature it gives off vapours, and on being distilled it is decomposed, but is partly reproduced in the receiver. It becomes moist quickly in the air, and with water breaks up, forming hydrochloric acid, sulphuric acid, nitric oxide, &c. It also decomposes immediately in English sulphuric acid, giving off torrents of hydrochloric acid: on distillation it yields a clear colourless liquid, which is probably Williamson's compound of hydrochloric and sulphuric acids,  $2SO_3 + HCl$ .

## NOTICES OF PATENTS.

1143. *Manufacture of Iron*. J. SHORTRIDGE, Sheffield. Dated May 6, 1864. (Not proceeded with.)

THE inventor dispenses with the use of the refinery and puddling furnaces ordinarily employed in the conversion of cast-iron, and substitutes a converting apparatus, which, receiving its charge from the blast furnace, effects the

purification and decarbonisation of the molten iron in a continuous operation.

1136. *Sugar Boiling*. E. BEANES, Argyll Street, London, and C. W. FINZEL, Bristol. Dated May 5, 1864.

IN the process of boiling sugar in the vacuum pans, the inventors employ a system of hot water pipes, or low pressure steam, as the source of heat.

1145. *Puddling Furnaces*. J. H. POOLE and J. ASTBURY, Wellington, Salop. Dated May 6, 1864. (Not proceeded with.)

IN the construction of puddling furnaces for the manufacture of iron, the inventors propose to make the converting chamber in such a manner that it may be turned upon a horizontal axis while the fire is operating upon its contents. The fireplace is itself constructed in the ordinary manner.

1169. *Material to be Used for Roofing or Covering Buildings, &c.* J. F. EMPSON, Birmingham. Dated May 9, 1864.

THE material described by the patentee consists essentially of a foundation of paper, or other fibrous material, the surfaces of which are coated with pitch or tar mixed with pounded slate or other gritty substances; or the inventor employs a mixture of pitch, tar, and asphalt, or other bituminous materials, in combination with chaff and hay, or flax and cotton waste, so as to make a plastic mass which can be moulded into sheets or slabs.

1172. *Calcining and Extracting the Oils and Gases from Ironstone and other Materials*. H. AITKEN, Falkirk. Dated May 9, 1864.

THE inventor treats black-band ironstone, bituminous shale, and other minerals yielding gas or oil by distillation in a special furnace, constructed with an inclined flue, which may be heated externally or not, according to circumstances. The mineral is charged into the upper end of this flue, and withdrawn, after complete calcination, at the bottom. It is recommended to mix the fuel with the powdered mineral, so that the operation may be continuous, and the gaseous or liquid products pass over, and may be collected in suitable receivers.

1192. *Manufacture of Blotting-paper*. J. BROWN, Aldgate, and A. P. PRICE, Lincoln's Inn Fields, London. Dated May 11, 1864.

FOR the purpose of increasing the absorbent power of blotting-paper, the inventors impregnate the sheets with an aqueous solution of glycerin, or they incorporate a small proportion of this substance with the pulp from which the blotting-paper is to be made.

1199. *Manufacture of Aniline Dye Colours*. O. SACHS, Aldermanbury, London. A communication. Dated May 12, 1864. (Not proceeded with.)

THE processes herein detailed are applicable to the manufacture of the blue and violet aniline dyes and to the purification of the same. The ingredients employed are red aniline dye, known as fuchsine, roseine, or aniline red, aniline oil, and common white soap. The last named substance is dried and reduced to powder previously to its employment. Two parts of aniline red are mixed with eight parts of aniline, and heated together until they form a thick paste, when the dried soap, in the proportion of one and a-half parts, is introduced. The mixture is maintained at a temperature varying between  $210^{\circ}$  and  $220^{\circ}$  C. for a period of time regulated according to the shade of colour to be produced; thus a red-violet will be formed in about an hour, a blue-violet in two hours, and a longer heating will produce a pure blue. The melted mass is then cooled, reduced to powder, mixed with an equal weight of benzol, and boiled off in order to separate the



excess of aniline; the residual colouring matters are then washed with boiling water, dried, and dissolved for use.

In this process the fatty acids of the soap are made to perform much the same function as the benzoic and acetic acids in the other modes of manufacture, which have of late been fully discussed.

1200. *Purification of Coal Gas.* J. PHILLIPS, Hatton, near Leeds. Dated May 12, 1864. (Not proceeded with.)

THE object of this invention is twofold—viz., the purification of coal gas and the manufacture of a manure. A crude superphosphate of lime is first made by digesting ground bones with sulphuric acid, and the mixture so formed is then used for absorbing the ammonia from coal gas.

A possible disadvantage may arise from the contamination of the manure with tarry and fetid products which may restrict its application for agricultural purposes.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

3080. F. G. Mulholland, Essex Street, Strand, "Improvements in purifying rosin or other substances of a similar kind and character."

3082. R. K. Johnson, Eccleston, "Improvements in the construction of glass-makers' 'pots,' and in the application of heat to the materials or glass 'metal' contained therein."

3084. R. A. Brooman, Fleet Street, "Improvements in, or a new or improved composition for, preserving and ornamenting stone, wood, and other substances."—A communication from F. Miller, Nancy, France.—Dec. 13, 1864.

3147. H. F. McKillop, Belvedere, Kent, "Improvements in compositions for coating or covering ships."—Dec. 19, 1864.

2788. J. A. Manning, Inner Temple, "Improvements in the collection and treatment of night soil."—Petition recorded Nov. 10, 1864.

2966. J. H. Johnson, Lincoln's Inn Fields, "Improvements in the mode of, and apparatus for, stopping bottles."—A communication from H. B. Goodyear, Newhaven, Connecticut, U.S.A.—Nov. 28, 1864.

3050. A. Surflen, South Crescent, Bedford Square, "An improved washing and scrubbing compound."—Dec. 7, 1864.

3108. J. A. Pols, Nye's Wharf, Surrey Canal, Old Kent Road, "Improvements in obtaining purified or refined oils, and in obtaining oil cakes for cattle food, and foots useful for soap making."

3210. C. Hancock, West Street, Smithfield, and S. W. Silver, Bishopsgate Street, "A new manufacture of certain flexible, elastic, waterproof sheets, surfaces, compounds, and substances, and the application thereof to various purposes."—Dec. 15, 1864.

3134. R. A. Brooman, Fleet Street, London, "An improved liquid meter."—A communication from J. A. Clement, Paris.—Dec. 17, 1864.

3160. H. Bird, Berkeley Street, Cheltenham, "Improvements in treating sewage matters."—Dec. 20, 1864.

3164. H. A. de Brion, Welbeck Street, Cavendish Square, "An improved varnish for protecting and preserving metals, such as polished steel, silver plate, silver-plated and electro-plated articles from oxidation, corrosion, and from the effects of damp or the action of sulphuretted hydrogen, and improved liquid for cleaning and brightening said articles."

3170. F. Tolhausen, Boulevard Magenta, Paris, "A new and improved method of aggregating coal dust."—A communication from C. Noble, New York, U.S.A. Dec. 21, 1864.

3185. J. Gillespie, Garnkirk, Lanarkshire, "The improved construction and manufacture of retorts, crucibles, glasshouse pots, and other similar vessels, and in the means and apparatus employed therein."—Dec. 22, 1864.

3195. R. A. Brooman, Fleet Street, "Improvements in coke ovens."—A communication from F. J. F. Laumonier, Angers, France.—Dec. 23, 1864.

3203. B. Margulies and J. K. Leather, St. Helens, Lancashire, "Improvements in the manufacture of chromates and bichromates."

3207. E. Morewood, Cheam, Surrey, "Improvements in coating metals."—Dec. 24, 1864.

#### NOTICES TO PROCEED.

2063. J. Thomsen, Copenhagen, "Improvements in batteries for generating electricity, and in apparatus for converting the quantity thereof into intensity."—Aug. 19, 1864.

2150. T. Fowler, Seymour, Connecticut, U.S.A., "An improved method of coating pins and other articles with tin or other metal."—Sept. 1, 1864.

2430. W. S. Cowles, New York, U.S.A., "An improvement in means for adapting casks and analogous structures to retain petroleum, naphtha, and the like fluids."—A communication from L. S. Robbins, New York, aforesaid.—Oct. 3, 1864.

2937. J. White, Finchley, "Improvements in means or apparatus employed in purifying, changing the temperature, and impregnating atmospheric air, which improvements are also applicable to the purification or separation of gases or vapours, and part of which improvements is also applicable in obtaining motive power for other purposes."—Nov. 24, 1864.

#### CORRESPONDENCE.

##### Continental Science.

PARIS, January 10.

A CURIOUS experiment has been made by Dr. Reichenbach, of Vienna. He believes in the existence of a cosmic powder or dust which exists all through space, and which sometimes becomes agglomerated so as to form large and small meteorites, while, at other times, it reaches the surface of our earth in the form of an impalpable powder. We know that meteorites are mainly composed of nickel, cobalt, iron, phosphorus, &c. Well, Dr. Reichenbach went to the top of a mountain which had never been touched by spade or pickaxe, and collected there some dust, which he analysed, and found it to contain nickel, and cobalt, and phosphorus, and magnesia. People have wondered where the minute quantity of phosphorus so generally distributed on the surface of the earth came from. The doctor, however, has discovered it in this mysterious invisible rain, which henceforth must be looked upon as quite as necessary for vegetation as the water which falls from the clouds. This is very pretty and poetical, but probably the discovery will not be universally believed.

No doubt, everything on this earth has its use and value, but certainly there is sometimes great difficulty in discovering it, and probably very few have ever imagined that the sting of a wasp or a bee was of any use or value, except to the animal itself or a microscopist. Now, however, we are told that a sting is a very valuable remedy, and *apisination* has a marvellous virtue in cases of marsh fever, yellow fever, headaches, nervous gastralgia, cholera, and the plague. Gasparin, we are told, cured himself of muscular rheumatism and of a bronchitis by the sting of a wasp. The remedy truly is not an agreeable one, but perhaps not much more disagreeable than a blister, and not so disagreeable as a moxa. It is rather a pity that the "Times' Bee-master" had not heard of this before he wrote his false and flattering notices of that busy, fussy insect,



which, like other busy creatures, is continually robbed of the fruits of its labour. It is unfortunate that a bee cannot write a notice of a "Bee-master."

The lovers of tobacco have here a journal to themselves, "The Smoker," which gives details that will shock members of any anti-tobacco society. From a recent number we get the following statistics of the consumption of the weed in France during 1862. It appears that in the year mentioned there were consumed 7,261,735 kilogrammes of snuff, and 21,013,356 kilogrammes of tobacco for smoking, making a total of 28,275,091 kilogrammes, which, taking the population at 37,129,336, gives an average of 196 grammes of snuff and 566 grammes of tobacco for each individual, women and children included. Some will say that there is here quite sufficient to account for the population of France remaining stationary.

M. Payen's lecture on coal gas at the Sorbonne drew a very crowded audience, and many were sent away disappointed by not getting admission. You have so recently given your readers a full account of the manufacture of gas, that I need not detain you with any extracts from the lecture, which, indeed, contained nothing of any novelty.

The scientific literature of France is so much read in England that some of your readers may be glad to hear that a second edition of M. Bequerel's work "On Electro-Chemistry" has just been issued. In this work all the valuable discoveries of late years have been brought together, and the various practical applications of the art are fully described. The book forms the most complete treatise on the subject that has ever issued from the press.

Father Secchi sends from Rome an interesting account of some lightning conductors which have been erected under his directions. The rev. gentleman prefers to adopt the old system of carrying the rods down into a pit filled with charcoal, and not into a reservoir of water—unless, indeed, this is very large. From the extremity of the rod he distributes a copper wire about the charcoal to carry off the discharge.

The Acclimatisation Society here still continue to make great exertions to carry out their objects. Recently, a quantity of silkworms' eggs have arrived from Japan, which are now in course of distribution to the provinces.

*Apropos* to this, M. Quatrefages has lately made the announcement that ungrafted mulberry-trees yield the leaves best suited for the nutrition of silkworms.

The cultivation of China grass is succeeding both in Belgium and France, and the acclimatisation of the plant seems to offer no serious difficulties. Men write as though it was expected soon to supersede flax, and even render cotton unnecessary.

M. Roudanovsky has lately made some interesting discoveries on the structure of nerves. He cuts very thin slices after subjecting the nerves to congelation, and with these he has been enabled to determine that the primitive elements of nerves are tubes having a pentagonal or hexagonal configuration. The walls of these tubes are formed of a conjunctive tissue, which in a bundle forms a true reticulum. As to the constitution, he says that every nerve has a substratum of brain matter, and also of the spinal marrow, and probably of the ganglionic matter also. The grey matter, he says, is the fundamental nervous substance, and plays the principal part in the functions. Energetic poisons, like strychnia and nicotine, affect the nervous cellules, while other poisons, such as opium, chloroform, and perhaps alcohol, modify the myeline.

#### Japanese Matches.

To the Editor of the CHEMICAL NEWS.

SIR,—The curious little Japanese firework, or one closely allied to it, has been long known to me. I saw it, when a boy, exhibited by an Italian juggler under the name of "Garofanetti," or "Pinks," alluding to the starry flower-

like coruscations produced by it. The sorcerer was of course reticent as to the formula, but I set to work and finally succeeded in finding it out. It is a form of the beautiful and very curious spur fire of the Chinese,—so curious as to be worth scientific investigation.

I enclose specimens, and here follows formula:—Lamp-black 5, sulphur 11, gunpowder from 26 to 30 parts, this last proportion variable with the quality of the powder. Grind very fine, and make the material into a paste with alcohol. Form it into dice, with a knife or spatula, about a quarter of an inch square. Let them dry rather gradually, as on a warm mantelpiece, not too near a fire. When dry, fix one of the little squares in a small cleft made at the end of a lavender stalk, or, what is better, the solid, straw-like material of which housemaids' carpet brooms are made (panicular stems of *Arundo donax*). Light the material at a candle; hold the stem downwards, and await the result. After the first blazing off a ball of molten lava will form, from which the curious coruscations will soon appear.

I am, &c.

R. TREVOR CLARKE.

[The specimens sent by our correspondent give coruscations of extraordinary beauty.—ED. C. N.]

### MISCELLANEOUS.

#### Wurtz's Lectures on Chemical Philosophy.—

As the publication of these lectures in the *Moniteur Scientifique* is very irregular, we have obtained permission (most readily conceded) to translate from the author's volume "Lecons de Philosophie Chimique." Our readers, we are sure, will unite with us in thanking the eminent author for the permission so liberally accorded. We shall commence the publication of the translation immediately.

"**Science Gossip.**"—We have much pleasure in welcoming this new candidate for public favour. The first number contains an excellent selection of articles on different branches of natural history, and a variety of extracted paragraphs giving information of much interest to naturalists. We believe the work will have much value for the young, and, indeed, all grown people whose hobby lies in the cultivation of natural history.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday and Thursday, January 17 and 19, at 3 o'clock, Professor Tyndall, "On Electricity." Friday, January 20, at 8 o'clock, Professor Tyndall, "On Combustion by Invisible Rays." Saturday, January 21, at 3 o'clock, Professor Marshall, "On the Nervous System."

### ANSWERS TO CORRESPONDENTS.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 10s. 8d., by post, 11s. 2d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

*B. E.*—Copies are to be bought at the Patent Office, Chancery Lane, and there is a register there which you can consult.

*Studiosus.*—1. See the announcement on this page. 2. We have papers of the kind in contemplation.

*G. F.*—The arrangements of the formulæ are altogether fanciful.

*A Reader* should go steadily through some elementary work.

*T. Ludwig*—Received with thanks. Two Numbers have been sent; the others shall be forwarded as soon as possible.

*A Regular Subscriber.*—Gessner's Practical Treatise on Coal, Petroleum, and other Distilled Oils, published by H. Baillière, Regent Street, London.

*I.*—It cannot be precipitated, but may be dissolved out and separated by sulphide of carbon.

*R. Y. Z.*—We can only refer you to our advertising columns for information on this subject.

*Received.*—X.; J. D.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Further Contributions to the Knowledge of Oxygen, by*  
C. F. SCHONBEIN.\*

*In what proportion does oxygen combine with the oxidisable material in the slow oxidations which take place with the co-operation of water?* The experimental answer to this question is of much importance to the theory of all slow oxidations, which so many organic and inorganic matters undergo at the ordinary temperatures and in the presence of water. My former experiments have shown that in the course of these water is always oxidised—that is, peroxide of hydrogen is formed. The fact that, under favourable circumstances, an ozonide and antozonide are reciprocally deoxidised to furnish in equivalent proportions  $\oplus$  and  $\ominus$  which unite to form the O becoming free—as, for instance, in the case of  $\text{HO} + \oplus, \text{MnO} + \ominus$  and  $\text{SO}_3$ , which give  $\text{HO}, \text{MnOSO}_3$  and  $2\text{O}$ —has long induced me to suppose that by a similar process, which I call the “chemical polarisation of oxygen,” the neutral oxygen in the course of slow oxidation of phosphorus, many metals, pyrogallie acid, and other organic substances, divides into  $\oplus$  and  $\ominus$ , the  $\oplus$  combining with  $\text{HO}$  to form peroxide of hydrogen, and the  $\ominus$  with the phosphorus, metals, &c., to form phosphoric acid and oxides. It follows from the accuracy of this assumption, that on shaking lead amalgam and oxygen with water containing  $\text{SO}_3$ , an equivalent of peroxide of hydrogen and sulphate of lead will be formed. The amounts of these are easily determined if we employ a definite quantity of water with a known proportion of sulphuric acid. The uncombined acid can be estimated by means of a standard potash solution, and oxygen combined with the lead inferred from the amount of sulphate. The peroxide of hydrogen can be easily determined by means of a standard solution of permanganate of potash,  $\text{KO}, \text{Mn}_2\text{O}_2\ominus_5$  corresponding to  $5\text{HO}\oplus$ . In this way, however, the full proportion of the peroxide can never be obtained, since it is easily decomposed by many metals, lead among them, and a part is always destroyed in the shaking with the amalgam. The amount destroyed is also sensibly influenced by the duration of the shaking, but more especially by the proportion of lead in the amalgam.

In a general way it may be stated, that the longer the shaking is continued, and the richer the amalgam in lead, the less peroxide will be found in proportion to the sulphate of lead. Under otherwise similar conditions we get by little shaking a larger proportion of  $\text{HO}_2$ , but in every case less than the equivalent for the sulphate of lead.

Among all the slow oxidations in which  $\text{HO}_2$  is formed, the one here described appeared to me the best fitted to give a practical answer to the question stated above, and it is therefore the only one I have employed in these experiments, which seem to show beyond doubt, that in the slow oxidation of lead the oxygen is halved, and as much is taken up by the metal as by the water.

After many experiments I have found that the best amalgam to employ, in order to get the largest proportion of  $\text{HO}_2$ , is composed of 200 parts of mercury to one part of lead. Rich amalgams, as we have said, give too little of the peroxide. One containing 5 per cent. of lead, for example, gives only half the amount which is found when an amalgam containing only 0.5 per cent. is em-

ployed. The water I used contained  $\frac{1}{500}$ th  $\text{SO}_3\text{HO}$ . 100 grammes of this was shaken with 200 grammes of the amalgam and pure oxygen in a flask holding two litres. 300 grammes of the acidulated water were successively treated by shaking with the oxygen and amalgam for an equal length of time. After the sulphate of lead had been separated by filtration, the free acid was determined in 100 grammes by saturating with a dilute solution of potash of such a strength that one gramme should neutralise one milligramme of monohydrated sulphuric acid. As 100 grammes of the acidulated water originally contained 200 milligrammes of  $\text{SO}_3\text{HO}$ , 200 grammes of the potash solution should be required for their saturation. But if only 151 grammes are necessary, the remaining 49 correspond to the same number of milligrammes of  $\text{SO}_3\text{HO}$  which have combined with oxide of lead; hence it follows that during the shaking 193.7 milligrammes of lead have united with 8 milligrammes of oxygen.

Another 100 grammes of the liquid was employed for the determination of the peroxide of hydrogen. For this I made use of a solution of permanganate of potash so titrated that one grm. contained one mmgr. of  $\ominus$ , and, therefore, would be decolorised by one mmgr. of  $\oplus$ ; or, which is equally the same thing, 8 grms. of the coloured solution of permanganate corresponded to 17 mmgrs. of peroxide of hydrogen †. Now if 100 grms. of the shaken acidulated liquid completely decolorises 8 grms. of the permanganate solution, we must conclude that that liquid contains 17 mmgrs. of peroxide of hydrogen, or 8 mmgr. of  $\oplus$ , and, consequently, that equal quantities of oxygen have united with the lead and with the water. It has been already remarked that the proportion of sulphate of lead to peroxide of hydrogen differs according to the duration of the shaking of the lead amalgam with the acidulated water, and that the longer the shaking is continued the greater becomes the excess of lead salt. To procure the largest proportion of peroxide, the shaking should not last longer than is necessary to form enough  $\text{PbOSO}_3$  and  $\text{HO}_2$  to estimate accurately. In a number of experiments in which the shaking lasted ten seconds the proportion of oxygen combined with the lead compared with that combined with the water was as 100:95; in single instances, indeed, it was as 100:98. But if the shaking is continued until the acidulated water but slightly reddens litmus paper, a perceptible quantity of  $\text{HO}_2$  will be found in the liquid, yet obviously very little in proportion to the sulphate of lead formed at the same time. And if the agitation be prolonged until the whole of the acid is neutralised, scarcely a trace of peroxide will be found in the water, so quickly is it destroyed by the amalgam when not under the protecting influence of the sulphuric acid.

It would appear impossible to obtain a full equivalent of peroxide of hydrogen for the sulphate of lead formed, but we have seen that in the experiment in which the shaking lasted ten seconds the amount came sensibly near to the theoretical quantity. If it were possible to determine the amount of sulphuric acid which becomes combined, and the amount of peroxide which is formed in the first seconds of the shaking, no doubt complete equivalents would be formed. It must be granted, then, that in the oxidation of the lead the oxygen divides itself equally between the metal and the water, and we are entitled to conclude that such a halving of oxygen

† Such a solution is made by dissolving 1.852 grms. of pure permanganate (containing 0.40 grms. of  $\ominus$ ) in 398.418 grms of water.

\* Abridged from the *Jour. für Prakt. Chemie*, bl. xciii., p. 24.



takes place during all other slow oxidations caused by the presence of water. But there must always be accessory circumstances depending upon the easy decomposibility of the peroxide of hydrogen, which prevent us from recognising this halving. If, for example, we are unable to detect peroxide of hydrogen in the blood, it does not follow that none is formed; for we know that the blood corpuscles possess in an eminent degree the power of destroying  $\text{HO}_2$ , which power they must obviously exercise upon the peroxide formed during respiration.

The influence exercised by some accessory circumstances will be seen from the following result:—In the mixture shaken for thirty seconds the proportion of oxygen combined with the lead was to that united with the water as 100 : 69. Some coal-dust added to the mixture before shaking reduced the proportion to 100 : 29; and more coal-dust shaken with the filtered liquor removed all trace of  $\text{HO}_2$ . There can be no doubt that  $\text{HO}_2$  is formed in the presence as well as the absence of coal; but by the decomposing action of the coal it is changed into water and ordinary oxygen. Spongy platinum having a still stronger decomposing action, it may be supposed that the presence of a small amount of that body would entirely prevent the discovery of  $\text{HO}_2$ .

The following is another example of the same kind:—Peroxide of hydrogen is formed when an alkaline solution of pyrogalllic acid is shaken with oxygen or atmospheric air, and can be detected by supersaturating the liquid with  $\text{SO}_3$ , and shaking it with an equal bulk of ether and a few drops of solution of chromic acid. The presence of peroxide is shown by the strong blue colour communicated to the ether. But if the potash solution is coloured decidedly red by defibrinated blood, we obtain under similar circumstances, a solution in which no  $\text{HO}_2$  can be detected, though there can be no doubt that the pyrogalllic acid is oxidised as well in the presence as the absence of blood corpuscles, and  $\text{HO}_2$  formed under both circumstances. As I have observed that the albumen of the defibrinated blood does not act catalytically on  $\text{HO}_2$ , it must be the blood corpuscles which induce the destruction.

Lately I have observed that there are many bodies in the animal and vegetable kingdoms which like platinum, coal, and blood corpuscles have the power of destroying  $\text{HO}_2$ . No peroxide is found in the blood after respiration, nor is it shown in the slow oxidation of organic matters in damp air, but it does not follow that none has been formed.

The foregoing I believe support my often repeated opinion that oxygen may exist in two oppositely active and in one neutral condition, and that these conditions may be changed one into the other. I have not yet ventured to express any supposition of the proximate causes for these conditions and their changes, but this much appears certain, that they play an important part in all oxidations which take place with ordinary oxygen and at common temperatures. The most important of these are the decompositions of organic matter, and the respiration of animals, in comparison with which all other oxidations which take place on the earth are insignificant.

Before we knew the different conditions of oxygen, we were obliged to believe that this elementary body threw itself upon the oxidisable material without itself undergoing any change. But the latest facts discovered appear to justify the belief that neutral oxygen can produce no effects of oxidation without dividing into two oppositely active conditions, or, as I have elsewhere

termed it, undergoing chemical polarisation; and this chemical polarisation appears to be the proximate cause of the comprehensive chemical changes which take place between atmospheric oxygen on the one hand and oxidisable materials on the other in the presence of water.

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*Production of Ammonia from Air and Water, under the Sole Influence of the Porosity of Arable Soil, by M. DECHARME.*

THE author set himself to determine this question:—Is arable soil, under ordinary conditions, capable, simply by virtue of its porosity, and the influence of humidity, of transforming part of the atmospheric nitrogen which penetrates and traverses it, into ammonia or ammoniacal salts?

Direct experiments have shown this to be possible. By passing 200 litres of air (at the rate of 10 litres per hour) freed from its natural ammonia, over 250 grammes of ordinary vegetable earth, previously washed, or calcined and washed, or estimated relatively as to its total of nitrogen, then restored to its usual state of humidity, and raised progressively from the temperature of  $10^\circ$  to about  $52^\circ$ , M. Decharme found that part of the nitrogen of this air had been transformed into ammonia, into carbonate and nitrate of ammonia.

The total amount of ammonia thus produced by the catalytic force of the earth experimented upon was at an average of 0.139 gr., a small absolute quantity no doubt, but in reality considerable if we compare the atmospheric ammonia to that of rain water.

This result corroborates and completes the explanation of several facts of importance in a physiological and agricultural point of view—among others, the good effect of airy drainage and ploughing, the improvement of land by fallowing, the formation of nitrates in the soil, cultivation without manure, the presence of nitrogen in plants growing in an artificial soil, deprived of nitrogenised matters removed from atmospheric air, and watered with pure water.

It also shows how all natural causes (winds, rains, changes of temperature and of pressure, &c.), or artificial causes (fallowing, drainage, &c.) which determine the introduction and movement of air in the soil, favour the production of ammonia, and contribute to the development of vegetation, a view perfectly in accordance with the facts observed in practical agriculture.—*Les Mondes*.

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## TECHNICAL CHEMISTRY.

*Contribution on the Manufacture and Refining of Cane Sugar, by CH. A. GOESSMANN, Ph.D., Syracuse, New York.*

MR. KESSLER has lately communicated, in a letter to Charles Barreswil,\* observations concerning the application of caustic magnesia for the defecation of the raw juice of the beet. The results obtained proved so very satisfactory that he is in favour of the use of caustic magnesia instead of caustic lime, which at present is almost universally applied for that purpose. As these statements cannot fail to attract the attention of the manufacturers of raw sugar, as well as of sugar refiners, I have thought that a further publication of observations of the same or similar import would prove acceptable to the parties interested.

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\* *Repert de Chim. Appliquée*, by Mr. Charles Barreswil. Paris, July 7, 1863. P. 252.



The fresh juice of the real sugar cane, obtained by pressure of powerful iron rollers, contains in solution sufficient of such nitrogenous matters as would produce, not only a rapid transformation of the entire amount of cane sugar into grape sugar (glucose), but also the subsequent destruction of the latter by fermentation. The tropical climate of the countries where the sugar cane is most successfully raised tends in a high degree to these disastrous results. Any means, therefore, which would effectually, and at the same time most rapidly, deprive these compounds of their obnoxious influence should in these localities deserve particular attention in preference to all others. Their removal by coagulation and precipitation, and not their destruction while still in their original solution, has been, for obvious reasons, the main aim of a successful defecation. Several acids, various basic oxides, and some of their compounds, have been known for a long time to precipitate more or less thoroughly a series of indifferent organic compounds similar to those which accompany the cane sugar in the cane juice, and quite a number of them have been actually recommended at different times for the manufacturing of the sugar more advantageously. Some oxides and their soluble compounds, probably best adapted to the producing of this effect, have been rejected on account of the danger arising from a possibility of neglect in removing poisonous compounds.† Baryta, it seems, has suffered the same fate for the same reason.‡ Caustic lime, which meets everywhere with favour, has retained its reputation thus far, probably not less on account of its superior action than on account of its cheapness and the harmlessness of its compounds. While a general preference has thus been conceded to the latter, there were always some reasons why the manufacturer of sugar felt disposed to listen to new propositions and try new experiments which might obviate the inconveniences arising from the use of caustic lime, or to substitute in its stead some compound more liable to expense, it is true, but more open to beneficial results. The steadily increasing price of bone black is one of the main causes which urges manufacturers and refiners to improve their methods, and to lend a more willing ear to new suggestions.

The more costly caustic magnesia, if proved efficient, might, even on that account, expect at present a fairer chance of introduction than it would have claimed at an earlier period in the development of the manufacturing, as well as the refining, of sugar.

Caustic lime is highly soluble in a solution of cane sugar—a peculiarity which may be the real source of the objections sometimes raised against its application for the defecation. I favour the opinion that the main disadvantages which may result from its use are due less to its inefficiency, compared with other means hitherto proposed for that purpose, than to the variable character of cane juice itself; for the kind of cane, season, soil, &c., mark their influence upon the latter, not to speak of the unreliable quality of caustic lime rather too commonly employed. In taking this view of the question, I believe I by no means deny or underrate the fact that those circumstances which cause the changeableness of the cane juice, &c., have been the source of many vexations, and that they require, in order to be successfully counteracted, the most careful attention on the part of a well-informed superintendent.

Considering the waste of cane sugar, in consequence of an inefficient removal of the ferment-creating compounds of the cane juice, the most-serious feature in the manufacture of sugar within the tropical climes, I cannot but believe the unavoidable darker colour, which even a careful application of caustic lime necessarily produces, the less of the two evils dreaded. Speaking of an unavoidable darker colour as a natural consequence of the use of caustic lime, it seems advisable to explain my meaning of that statement. Caustic lime, although considered a very efficient means of rendering most of the obnoxious compounds of the cane juice insoluble near or at the boiling point, does not remove them entirely at that temperature, as experience plainly shows. Such an effect requires a continued boiling of the slightly alkaline liquid. The usual manner in which the defecation of the cane juice is carried on absolutely excludes, as we are aware, such a proceeding; and as heat alone does not destroy rapidly enough the fermenting compounds, a certain degree of an alkaline reaction in the defecated juice must prove to be the best protection of the cane sugar, since it secures the subsequent destruction of the compounds in question. While thus a slight excess of caustic lime secures a good result as regards the quantity of cane sugar finally obtainable, it causes, on account of that desirable effect, quite a considerable increase of colour in the cane juice and in the syrups during the process of the manufacture. The danger of neglect in the use of different methods merits serious attention when commenting on the means to be taken in order to have satisfactory results. However, this danger ought not to influence too exclusively the final conclusion as to the means, since, to make a fair comparison between them, we must suppose equal care in the execution of the processes. To ascertain the proper quantity of lime necessary to procure an increased percentage of cane sugar as a compensation for the pecuniary disadvantages, resulting from a darker colour in the clarified juice, will doubtless be considered a much easier task by sugar masters in the tropical climates than to obtain a satisfactory percentage of the better qualities of raw sugar from an imperfectly defecated cane juice.

Before I had witnessed § the rapidity and the extent of the decomposition of cane sugar during the manufacture of the raw sugar, I felt somewhat inclined to believe that the good results which I had observed in many instances in the refining of the latter by the application of caustic magnesia might find a further illustration in the defecation of cane juice.

Yet my own personal observations while in Cuba have altered my opinion, and I am now strongly inclined to believe that the “exclusive” use of caustic magnesia in the warmer climate for defecation would be both an expensive and dangerous experiment, at least so long as the present system of manufacturing is adhered to in its main features. In regard to countries of a more moderate clime, I do not assume to express any opinion, for my experience does not entitle me to question any of the results reported by Mr. Kessler. My doubts of the efficacy of caustic magnesia for the purpose above mentioned in said localities are also strengthened by the results of a series of experiments which I made several years ago. || Those experiments were made partly for the purpose of confirming my views with respect to certain statements in our chemical literature, partly also

† Liebig and Kopp's *Jahresbericht*, 1847-48, p. 1106; and 1849, p. 704; and 1850, p. 68. Patent Office Report, 1849-50, p. 463.

‡ Leplay and Dubrunfaut, Liebig and Kopp's *Jahresbericht*, 1863, p. 753. *Repert de Chim. Appliquée*, ii., p. 169.

§ These observations date from the winter of 1860 to 1861, while visiting the island of Cuba.

|| These experiments were made in 1857, when I was engaged in studying the efficacy of caustic magnesia for refining purposes.



for the purpose of comparing the effects of caustic lime and caustic magnesia under certain corresponding circumstances. I here briefly state the results, as far as they bear upon the subject in question, for the purpose of enabling parties interested to form their own opinion as to the consequences, and to supply any deficiency, if such is their wish. I proposed to myself the following questions:—

1. What influence has caustic lime upon cane sugar and upon grape sugar?
2. Does atmospheric air or pure oxygen gas influence the effect of caustic lime upon the two kinds of sugar in question?
3. Does a ferment, dissolved in a solution of cane sugar, retain its peculiar influence upon the various kinds of sugar after having been subjected to a boiling heat?
4. What influence has carbonate of lime under the circumstances stated in the previous question?
5. How does a ferment act upon cane sugar in the presence of either caustic lime or caustic magnesia?

The remarkable solubility of caustic lime in a solution of cane sugar has been the subject of a series of investigations, the result of which ¶ tend in a great part to establish the following facts:—Caustic lime, under different circumstances, forms different combinations with cane sugar. More concentrated solutions of the latter dissolve larger quantities of the former, and the combinations formed in some instances are more soluble at common temperature than at their boiling point, for heated they form, by a certain concentration while insoluble, compounds in the form of precipitates.

When engaged in repeating the former mentioned experiments, I became convinced that cane sugar is not changed by caustic lime, and that it may be separated again completely, and remain unchanged. Grape sugar, heated with caustic lime, is easily destroyed, and forms, according to temperature, more or less of a resin, like hemin, a substance composed of carbonic acid and of formic acid.\*\*

Access of air does not alter materially in either case the effects mentioned, for cane sugar does not suffer at all, and grape sugar seems only to produce the volatile acids in a larger proportion. The effects of pure oxygen gas upon both kinds of sugar in the presence of a basic oxide—for instance, caustic lime (or caustic baryta)—differ much in intensity. The experiments which elicited this fact were thus made:—At common temperature, and over mercury, I filled two long-necked glass flasks, one partly with a solution of grape sugar, the other partly with a solution of cane sugar (both solutions containing an equal amount of caustic baryta dissolved), and partly with oxygen gas. The solutions rested in both cases upon a broad sheet of mercury. I substituted caustic baryta for caustic lime for this reason, that it would enable me to produce, as far as possible in both cases, colourless solutions with an equal percentage of the basic oxide. The solution of cane sugar remained for weeks almost unchanged. The corresponding solution of grape sugar absorbed rapidly the oxygen gas, with hardly any change in colour. The absorption in either case was favoured by a repeated shaking, and took place at common temperature. The final results in the latter case consisted of a slightly yellowish solution, which contained formylate of baryta and an excess of caustic baryta, while some carbonate of baryta was separated. It required a considerable time to destroy

the last trace of colour. V. G. Besanez †† has lately published some interesting observations on the effect of ozone upon various organic compounds. He obtained with grape sugar such results as I myself obtained with oxygen gas. The quantity of oxygen gas originally brought in contact with the solution in question was repeatedly renewed, and in every case almost entirely absorbed. Whether this contained ozone, and in what quantity, I cannot state, for I made no test for the purpose of ascertaining it.

(To be continued.)

## PHARMACY, TOXICOLOGY, &c.

*Bismuthi et Ammoniae Citras*, by N. GRAY BARTLETT.\*

A PREPARATION, under the somewhat empirical name of "Liquor Bismuthi (Schacht)," was introduced to the profession, some years since, in England, and more recently it has been the subject of several notices in foreign medical publications.

This liquid contains a bismuthic salt in permanent solution, and is miscible with water without precipitation. Its reaction is alkaline, and it possesses but little taste. These desirable properties in a remedy usually administered in a comparatively insoluble condition would seem to indicate that this solution had not received undue attention.

It is asserted by the originator, M. Schacht, apparently after abundant observation, that a fluid drachm of his preparation, containing one grain of teroxide of bismuth, is equivalent in medicinal value to a full dose of the subnitrate of bismuth.

The liquor bismuthi was subjected to analysis by Mr. Tichbourne, who found its constituents to be bismuth, citric acid, and ammonia. (*Lond. Pharm. Journ.*, Jan. 1, 1864.)

Following the directions of that gentleman for its preparation, recently precipitated teroxide of bismuth was boiled in a solution of citrate of ammonia. Repeated trials proved the oxide to be but sparingly dissolved by this treatment, and demonstrated the impracticability of this process. The alternative method suggested—that of substituting citrate of bismuth for the oxide—yielded a more satisfactory product.

The writer, having observed the solution of citrate of bismuth, obtained by the addition of ammonia, to have an acid reaction, and also that an excess of that alkali occasioned a precipitate of oxide of bismuth, inferred the existence of a compound salt of bismuth and ammonia. This was subsequently confirmed.

The following formulæ, suggested by theory and numerous experiments, were finally adopted:—

**Bismuthi Citras.**—Take of subcarbonate of bismuth a troy ounce; citrate of potassa a troy ounce and 120 grains; nitric acid a troy ounce and a half; distilled water a sufficient quantity. Dissolve the subcarbonate of bismuth in the nitric acid, and, when effervescence has ceased, dilute the solution with a fluid ounce and a half of distilled water, gradually added. Dissolve the citrate of potassa in two pints of distilled water, and to this liquid add slowly, with constant stirring, the acid solution of bismuth.

Permit the mixture to stand for several hours; then pour it on a moistened paper filter, and when the liquid

¶ *Comptes Rendus*, xxxii., pp. 333-469. Peligot, Subeiran, Pelouze, &c.

\*\* Compare Chevalier and Cottureau, Peligot, &c.; Berzelius' *Jahresbericht* for 1846.

†† *Annalen der Chem. u. Pharm.*, Wöhler, Liebig, and Kopp. 1863. No. for February, p. 211.

\* *American Journal of Pharmacy*. January, 1865.



has nearly ceased to pass, cover the surface of the precipitate with distilled water.

Repeat this operation until the washings no longer contain nitric acid. Allow the magma to drain, and dry it on bibulous paper with a gentle heat.

**Bismuthi et Ammoniae Citras.**—Take of citrate of bismuth, in powder, a convenient quantity; stronger water of ammonia, distilled water, each a sufficient quantity. Rub the citrate of bismuth with sufficient distilled water to reduce it to a uniform pasty consistence, and add cautiously, with constant trituration, stronger water of ammonia until a solution is obtained, observing to avoid an excess of ammonia.

Filter the liquid through paper, returning the first portions that pass, should they be turbid.

Spread the clear solution on glass, that the salt may dry in scales.

**Liquor Bismuthi et Ammoniae Citratis.**—Take of citrate of bismuth and ammonia 260 grains; alcohol, two fluid ounces; distilled water, fourteen fluid ounces; water of ammonia, a sufficient quantity. Dissolve the citrate of bismuth and ammonia in the distilled water, neutralise the liquid with water of ammonia, and mix it with the alcohol.

Or, take of citrate of bismuth, recently precipitated, and still moist, a convenient quantity; water of ammonia, alcohol, distilled water, each a sufficient quantity. Add gradually to the citrate of bismuth water of ammonia, until the precipitate is dissolved, and a neutral solution is obtained. Dilute this with its volume of distilled water, and filter through paper, returning the first portions of the filtrate, if necessary, until the liquid passes clear.

To half a fluid ounce of this solution add hydrosulphate of ammonia in slight excess. Pour the mixture on a tared paper filter, wash the precipitate thoroughly with distilled water, and dry it at a temperature of  $212^{\circ}$ . Weigh the filter and its contents, deducting the weight of the former to obtain that of the tersulphide of bismuth, which, in grains, is to form a third term in a rule-of-three proportion, thus:—

$$\begin{array}{cc} (\text{BiS}_3) & (\text{BiO}_3) \\ 261 : & 237 : : \end{array}$$

the weight of tersulphide of bismuth to that of teroxide of bismuth in half a fluid ounce of the solution.

Apply the same ratio to the remainder of the liquid, and dilute it to such an extent that a grain of teroxide of bismuth will be contained in each fluid drachm of the finished solution; seven-eighths of which measure must be made up with distilled water, and the remainder with alcohol.

For preparing the citrate of bismuth, the subcarbonate is preferable to the subnitrate, because of its more uniform composition, as well as its greater purity, at least in commercial specimens of these salts. The metal itself is inferior to either, as it is almost invariably contaminated with arsenic.

The bismuth and potassa salts are employed in nearly atomic proportions for the production of a neutral citrate of bismuth; the potassa salt, however, is in slight excess, on account of its deliquescent nature. By using solutions considerably diluted, the precipitate is rendered less dense, and the washing, by displacement, is thereby facilitated. This is a tedious part of the process, but the best means of accomplishing the purpose. Washing by decantation is inapplicable, for, before it has been carried to a sufficient extent, a portion of the powder will remain suspended in the liquid, and can only be separated by boiling.

It also entails a greater loss of the citrate of bismuth, which is slightly soluble in water. The absence of nitric acid from the washings can be judged of approximately by the taste, but better by faintly tinging a portion of the liquid with sulphate of indigo, and boiling in a test-tube for a few minutes; if the colour be retained, no nitric acid is present.

In the preparation of citrate of bismuth and ammonia, the citrate of bismuth previously dried is employed, in order that a concentrated solution may be obtained without resort to evaporation, as the heat necessary in this operation occasions a precipitate, caused, apparently, by a loss of ammonia.

The solution should be spread with a brush, on panes of glass, to dry.

Citrate of bismuth and ammonia, as thus prepared, is in the form of brilliant, white, semi-translucent scales, not at all deliquescent, but readily soluble in distilled water.

An aqueous solution of this salt, if long kept, like those of the citrates in general, is subject to spontaneous change. The addition of small portions of alcohol and ammonia, as indicated in the formulæ for a solution of citrate of bismuth and ammonia, will, it is believed, preserve it indefinitely. The same result could probably be secured by means of sugar, with the additional advantage of a more agreeable taste.

The composition of the compound salt, determined by direct analysis, is as follows:—

$\text{BiO}_3$	=	237	=	50.11 per cent.
$\text{NH}_4\text{O}$	=	26	=	5.50 „
$\text{C}_{12}\text{H}_5\text{O}_{11}$	=	165	=	34.88 „
$5\text{HO}$	=	45	=	9.51 „

$$\text{BiO}_3, \text{NH}_4\text{O}, \text{Ci} + 5\text{HO} = 473 \quad 100.$$

The bismuth contained in the washings can be recovered by neutralising them with ammonia, and treating with sulphuretted hydrogen. The precipitated tersulphide of bismuth, after having been washed and dried, may be reduced to the metallic state, or converted into the subcarbonate by suitable means.

The writer is unable to state any facts in relation to the therapeutical properties of citrate of bismuth and ammonia. Owing to its solubility, it would undoubtedly be more perfectly diffused over the mucous surfaces, or more readily absorbed into the system, than the ordinary salts of bismuth.

Accepting the evidence of M. Schacht as conclusive, the dose of this salt would be two grains, or of the solution a fluid drachm.

Chicago, Illinois, November, 1864.

## PHYSICAL SCIENCE.

### On Appliances for Taking Deep Soundings, by T. TWINING, Esq.

IN 1833 and the following years, I occupied myself with inventing appliances for taking deep soundings, and tried a variety of experiments with that view on the Lake of Thun, in Switzerland, where my apparatus used to go to the bottom and return to the surface without line. Wishing to add thermometrical as well as barometrical observations, I contrived an upright minima thermometer, and was led from that to a more useful maxima thermometer on the same principle, which is the one I described to you some time since, and of which, encouraged by your approval, I now take the liberty of forwarding to you a drawing and description.



It is a spirit thermometer, having, about one-third of the way up the tube, a small bulbous enlargement, in which is lodged a globule of mercury, which serves as an indicator. As long as the spirit rises, this globule remains stationary; but as soon as the spirit descends, it descends likewise, lengthening into a small cylinder about  $\frac{1}{10}$ th or  $\frac{1}{12}$ th of an inch long, which cuts in two the column of alcohol. It is evident that on adding to the degrees marked by the extremity of the spirit column those shown by the inferior extremity of the indicator on the lower scale, we ascertain at once the maximum of heat to which the apparatus has been exposed.

It is thus that I made a course of observations on the summer heat of the valley of Interlacken. My thermometer was suspended in a convenient place just outside the window where there would not have been room enough for an ordinary horizontal maxima. Every morning the addition of the indications on the two scales was made to obtain the maximum heat of the preceding day. The bulb of the

instrument was then warmed with the hand till the mercury reached the enlargement; the instrument was laid flat whilst the spirit came down, and the thermometer was then hooked up again ready for the day's observation.

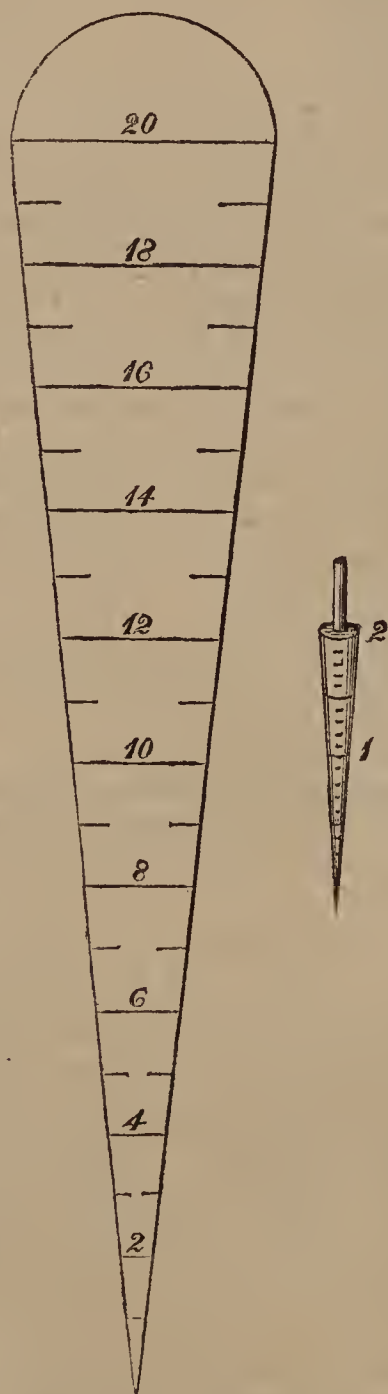
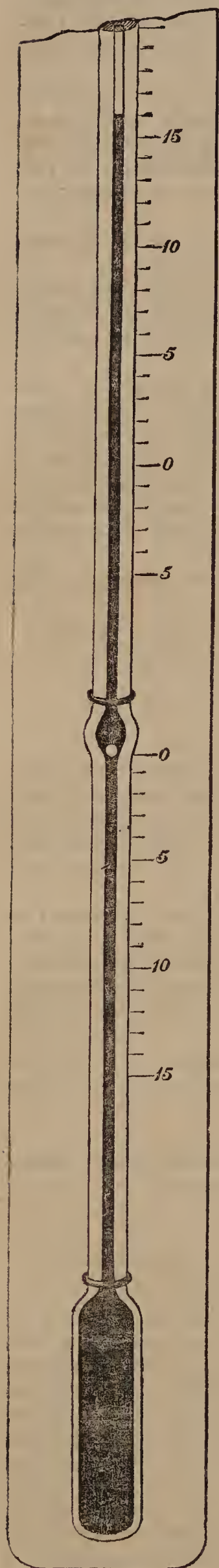
Having had suitable tubes made by a glass-blower at Paris, I had no difficulty in filling, mounting, and graduating several thermometers of the above description. The only operation which required rather more than ordinary care was the graduating of the lower scale. It was necessary to mark, one at a time, the first two degrees, on account of the widening of the tube in this part.

I at first apprehended that the globule of mercury might not always be quick enough to join the descending column of alcohol, but repeated trials convinced me that my apprehensions were not founded, and the only objection which my thermometer is open to, besides those which to some extent always attach to spirit thermometers, is this, that if a considerable time is allowed to elapse between the hour of maximum temperature and the recording of the observation, the mercury will be apt to move in a slight degree from its place, sliding gradually through the spirituous fluid. A series of special experiments in reference to this peculiarity has convinced me that it does not proceed from any preventible cause, and that from its irregularity it cannot be made allowance for; but at the same time I have found that the movement in question is so slight as not to affect the practical usefulness of the instrument for daily observations of temperature, or to counterbalance the advantages which it presents—1stly, as a means for taking observations where only an upright thermometer can be used; 2ndly, as not being affected by travelling; and 3rdly, as an appliance which almost every ingenious mechanic may make for himself at a very small expense.

By suspending this thermometer bottom upwards, it may be made to serve to a certain extent as a minima thermometer, but with this drawback, that after each observation a stronger degree of cold than that recorded must be artificially produced to bring the mercury back into its cell, which cannot always conveniently be done; whereas in the case of maxima of heat the mercury is easily put to rights by the application of the hand to the bulb, or if that should not be sufficient, by a little artificial heat.

I have mentioned that barometrical as well as thermometrical observations were connected with my sounding experiments on the Lake of Thun. The barometer which I used was one made by myself on a principle analogous to that adopted by Gay Lussac, but presenting certain advantages which I shall be happy to explain if desired. In the meantime, I beg leave to draw your attention to two little appliances which I found very useful in ascertaining whether the tubes which I required for various purposes were of equal bore, or nearly so, at both ends, as well as for insuring accuracy in the selection of the calibres required.

The larger one is a slip of brass shaped like a wedge, ten centimetres long and two centimetres across at its widest part. On introducing it, as far as it will go, into the ends of a tube, the calibre of the latter in millimetres is indicated to a nicety by the graduated scale which shows the width of the wedge in the various parts of its length. The smaller instrument, used in a similar manner for narrow tubes, is a silver cone very carefully made and graduated, and having two centi-





metres in length with a largest diameter of two millimetres.

Perryn House, Twickenham, January, 1865.

## PHOTOGRAPHY.

*Chloride of Iron, by M. JEAN OBERNETTER.*

HAVING remarked the property possessed by chloride of iron of converting finely powdered silver into chloride of silver, and of redissolving this compound after its formation, M. Obernetter proposes to employ it in the following ways:—

1. To remove stains of silver from the hands, clothes, &c., it is only necessary to apply the solution to the spot with a brush or pencil, and then to wash it. Chloride of iron is not injurious to the skin, and is preferable to cyanide of potassium, which is so dangerous.

2. To reduce to a proper degree a too black negative plate, pour, after fixing the proof, a greatly diluted solution of chloride of iron on its surface, and when the desired depth has been produced wash it well. By this means the most delicate details remain uninjured.

3. To make faint negatives deeper, run a weak solution of chloride of iron over the glass plate; then strengthen with pyrogallie acid and silver mixed.

The operation should be performed in diffused light, in order to facilitate the reduction of the chloride of silver.

This method is especially adapted for obtaining instantaneous proofs.—*Bulletin de la Société Chimique*, 399, 64.

## PROCEEDINGS OF SOCIETIES.

### PHARMACEUTICAL MEETING.

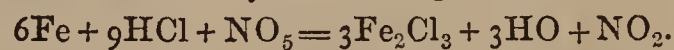
Wednesday, January 4.

Mr. SANDFORD, President, in the Chair.

(Continued from page 19.)

Dr. ATTFIELD'S paper was entitled "*Notes on the Chlorides of Iron, and the Methods of Making Solution of Perchloride of Iron of Constant Strength.*" The following is a short abstract of the paper. Theoretically—and practically also, when a pure solid compound is required—the simplest way of forming a chloride of iron is to bring together the two elements. This may be done on the small scale by passing dry chlorine into a flask about a third filled with iron nails, and kept at nearly a red heat. Under these circumstances protochloride is formed when iron is in excess, and perchloride when chlorine predominates. The latter sublimes at a lower temperature than the former, and will be found adhering to the upper part of the flask in the form of dark green iridescent scales. If the operation be stopped before the whole of the nails have been acted upon, the residual iron will be found compacted together by small micaceous crystals of the protochloride. Anhydrous perchloride of iron rapidly absorbs moisture, but once dissolved in water it gives a liquid which will probably remain unimpaired for any length of time, unless heated, when it decomposes and hydrochloric acid is evolved—a fact which should be remembered by the analyst and the pharmacist. Sometimes the oxide precipitated dissolves as the solution cools, but this is only when much perchloride remains undecomposed, and depends upon the solubility of the oxide in a solution of the chloride. Perchloride of iron is also soluble in ether and alcohol, but these solutions are unstable; they soon become opalescent, and basic chloride is deposited. Heat in both cases accelerates this decomposition. Under the continued influence of light another

reaction occurs with these solutions; the perchloride of iron becomes reduced to protochloride, and the chlorine set free combines with the carbon and hydrogen from the ether or alcohol to form probably chlorides of ethyl and ethylene, and chlorinated derivatives of those bodies. It would seem that this reaction soon occurs, for solutions of the perchloride in alcohol or ether soon acquire the odour of the bodies alluded to. Protochloride of iron dissolves in water, alcohol, and ether, but forms unstable solutions. An aqueous solution decomposes when boiled, and moreover the protochloride volatilises to a considerable extent with the water. A semi-spirituous solution of the neutral perchloride, such as the tincture of British Pharmacopœia, is very unstable, but the addition of a few drops of hydrochloric acid to each ounce will prevent decomposition. Another method of making perchloride of chlorine is first to prepare a solution of the protochloride by dissolving iron in hydrochloric acid, and then passing chlorine into the solution. To make a solution of the officinal strength, two ounces of fine iron wire must be placed in a mixture of six and a-half fluid ounces of hydrochloric acid (sp. gr. 1.17), and three and a-half ounces of water. When the iron is dissolved the carbonaceous residue must be separated and chlorine passed into the solution until it gives no precipitate with ferridcyanide of potassium. The excess of chlorine must be got rid of by boiling, in which operation much hydrochloric acid is lost, and the solution consequently becomes very basic. The third process noticed was that of the British Pharmacopœia. Iron is dissolved in hydrochloric acid, and nitric acid is added to the solution. In this process the hydrogen of the uncombined acid is oxidised, and the chlorine set free unites with the protochloride of iron, binoxide of nitrogen escaping. The whole reaction may be thus expressed,—



This process is open to numerous objections, and only by chance yields a pure product, that is, a neutral solution of the perchloride. If an exact proportion of real hydrochloric acid be employed, the solution decomposes in the boiling necessary to get rid of the black compound with binoxide of nitrogen, but when more hydrochloric acid than is necessary for the reaction is used, the solution, excepting the presence of the hydrochloric acid, is all that can be wished. Dr. Attfield next discussed the British Pharmacopœia process for "*Liquor Ferri Perchloridi.*" When this process is strictly followed the solution contains pernitrate of iron, and is deficient in hydrochloric acid during evaporation. By using the theoretical quantity of nitric acid, four fluid drachms eighteen minims (according to Ure's table) and a little more hydrochloric acid than the Pharmacopœia directs, the Doctor has succeeded in forming a solution of the officinal strength which contains no nitric, but of course an excess of hydrochloric acid, and which gives with spirit a solution which may or may not be stable. The fourth process referred to was preparing a solution of perchloride by dissolving peroxide in hydrochloric acid. This process, which looks so simple, is perhaps the most uncertain and complicated of all. It involves the preparation of a pure peroxide, which is not easy to procure. Dr. Attfield recommends pharmacists never to employ this method in making the tincture of the sesquichloride. In conclusion, he recapitulated the chief points of the paper, and stated that the only method of producing a pure solution of perchloride of iron of officinal strength is to dissolve the anhydrous perchloride in water; such a solution is stable in the cold, and can be prepared of definite strength. Finally, he condemned the use of the so-called tincture, which, however, he admitted, was not liable to decomposition when a slight excess of acid was present.

The discussion on this paper was deferred until the next meeting.



## ACADEMY OF SCIENCES.

January 9, 1865.

It may be noted, as an unusual circumstance, that no chemical paper was read at this meeting. One or two papers of considerable interest on other branches of physical science were, however, communicated. One of these was by M. Carlier, "*On a New System of Electro-Magnets with Uncovered Wire.*" An electro-magnet consists essentially of an iron cylinder covered with a helix of metallic wire, through which passes a current of electricity. Until now it has been supposed necessary to insulate the wire composing the helix by covering it with silk, cotton, gutta-percha, or some other insulator. M. Carlier, however, finds that the covering is not only unnecessary, but disadvantageous. By using an uncovered wire, but separating the layers of spirals one from the other by paper envelopes, the magnetic effects are twice as strong as when a covered wire is employed.

M. l'Abbè Laborde described "*An Apparatus for Simplifying Spectrum Analysis.*" With this apparatus he is enabled to observe the spectra of metals with a small induction coil and a pocket spectroscope, and to compare the spectra of two metals at one time. The description of the apparatus is almost unintelligible in the absence of illustrative cuts, but one remark which the author makes must be quoted. He says that the colour of the bands is a very uncertain means of recognising a metal, and it is far more certain to determine the position of those first seen. He notes in every metal bands of different visibilities, just as in a constellation stars of different sizes are seen. We shall probably return to this paper.

M. Tellier made a communication "*On the Use of Ammoniacal Gas as a Motive Force;*" he gave, however, only the crude idea, without details of the machinery he intended to employ in drawing an omnibus through the streets with two ammoniacal horses. Ten kilogrammes of liquified ammonia, he states, will do the work of one horse for an hour.

## NOTICES OF BOOKS.

*Zeitschrift für Chemie und Pharmacie.* Nos. 22, 23. 1864.

Most of the papers which appear in these two numbers of this journal have already been noticed in connection with other journals, or have appeared at length in the CHEMICAL NEWS. In No. 23, however, we find a *Method of preparing sodium amalgam*, which may be useful to some of our readers. The author, Dr. Mulhauser, fuses sodium in a deep dish under naphtha, and adds the mercury gradually in a fine stream, which occasions a slight hissing, and inflames the naphtha. The sodium swells up, and forms at last a solid mass, which may be allowed to cool under the naphtha. In this way a pure product of definite composition may be procured without loss.

Werigo communicates a second "*Preliminary Notice on the Action of Sodium Amalgam on the Homologues of Nitrotoluol.*" With nitrotoluol he obtained a red crystalline body, azotoluid  $C_{14}H_{14}N_2$ ; similarly he has obtained with nitrocymol, azocymid in the form of micaceous colourless plates. With nitroxylol and nitrocumol he has procured bodies which he has not yet analysed, but which must be azoxylid and azocumid. Bodenbender gives a "*Notice of the Action of Mannite on Oxide of Copper in Alkaline Solution.*" The products of this reaction are not constant, as in the case of grape sugar. Among the products the author found an organic acid, the nature of which he has not yet determined. We may add that he tried various means for transforming mannite into grape sugar, but met with no success.

*Journal für Prakt. Chemie.* No. 21. 1864.

THIS number contains two papers of interest to mineralogical chemists. One is by Professor Kenngott "*On the Composition of Staurolite;*" and the other, by Dr. C. Bischoff, "*On the Quantitative Estimation of the Alkalies in Basalt in Different Conditions.*" The next paper is by Professor Schrotter, "*On a Simplified Process for Extracting Lithium, Rubidium, Cesium, and Thallium from Lithia, Mica, and Lepidolite.*" We shall give an account of this process. A short paper, by Liebig, "*On Extractum Carnis,*" insists on the usefulness of this preparation, and strongly recommends its preparation and exportation to Europe from South America and other countries where meat is cheap. In England we shall probably prefer to have the beef itself at 3d. per pound. Three papers by Gentele follow—" *On Some Platinum Bases;*" "*On the Aldehyd of Formic Acid;*" and "*On Chemical Formulæ.*" These will only interest advanced chemists.

## NOTICES OF PATENTS.

1036. *Puddling Iron, Steel-iron, and Steel.* H. BENNETT, Wombridge, Salop. Dated April 23, 1864.

THIS invention consists of an improved method of puddling iron or steel by subjecting the pigs to a strong heat prior to their introduction into the body of the puddling furnace. This object is attained by placing hollow bars, through which a stream of cold water is kept constantly running, either over the firegrate or over the body of the furnace at a distance of about six inches beneath the crown; the pigs are introduced through a door at the end of the furnace placed above the usual fire door, and are laid upon the water bars, where they become heated during the working of a previous charge, so that by the time the first bloom is formed and removed from the furnace, the second charge of pig, above it, is nearly in a melting condition, and when now transferred to the bed of the furnace very quickly enters into fusion, while the spare heat is, as before, made available for the preliminary heating of a fresh charge of pig iron.

The process here described cannot fail to prove advantageous as a means of economising fuel, and the mechanical arrangements are such as would be applicable to existing furnaces. As a further improvement in the same direction, we would suggest that the blast furnace be surrounded, or placed in communication, with a series of puddling chambers, into which separate charges of the molten iron could be run directly after its reduction; or, if an intermediate process of purification must be resorted to, the refinery furnace may become the centre from which to draw supplies of the fluid metal.

1060. *Producing Photographic Pictures Photogenically Indelible.* R. A. BROOMAN, Fleet Street, London. A communication. Dated April 27, 1864.

THE objects contemplated in this invention are the production of photographs upon, or transfer of photographs to, the surfaces of porcelain, glass, rock crystal, lava ware, or amianthus fabrics, and afterwards burning them in with fluxes as in the enamelling processes. Or, the ordinary photographs upon glass may be intensified by any of the known processes, and the silver thus deposited be firmly attached to the glass by the action of fire; or, lastly, salts of gold and platinum may be used to modify the colour of the pictures, and confer additional permanence. In some cases it is intended to convert the film of pure metal into chloride or iodide by exposing the surfaces to chlorine gas or to the vapours of iodine, and then to promote the attachment of such compounds of silver to the glass by the application of a moderate heat. The use of pigments is also mentioned in the specification.



1083. *Manufacture of Iron.* W. C. CAMBRIDGE, Bristol.  
Dated April 29, 1864.

THE patentee mixes broken or powdered iron ore with clay, limestone, or other suitable flux, and adds scrap or waste iron in the form of turnings or borings, and makes them up with water into plastic masses, from which blocks are afterwards formed suitable for charging the blast furnace.

A similar method of proceeding was tried some years ago in connection with the Taranaki iron sand, but we do not know whether the scheme proved successful.

1124. *Compound or Composition for Artificial Stone.* H. POTTER, Manchester. Dated May 4, 1864.

THE inventor prepares a hard and durable material which is suitable for many purposes to which stone is now applied, by mixing together sand and iron filings or borings, making them into a paste with water, and allowing the mass to harden by the operation of rusting whilst enclosed in caissons or suitable boxes. The proportions recommended are ten parts by weight of sea or river sand to one of the cast or wrought iron borings.

1128. *Apparatus for Securing Stoppers for Bottles.* J. THOMPSON, Hildrop Crescent, Camden Town, London.  
Dated May 4, 1864.

WITH the view of preventing mistakes in dispensing, the inventor makes use of a capsule cover for securing the stoppers of all bottles containing poisonous tinctures, &c. The said cover is made of a little disc of metal having an aperture cut out of it which passes over the square head of the stopper, and, by a little binding screw on one side, is fastened to the neck of the bottle, whilst a tag or loop on the other side completes the arrangement.

1185. *Blast Furnaces.* M. MORGAN, Brendon Hills, Somersetshire. Dated May 10, 1864.

THIS invention relates to the construction of blast furnaces with a central core, through which, if desired, may be established an air blast. The core is made of a conical shape, and may be either solid or hollow, and rise to any desired height in the centre of the furnace; the ordinary tuyeres are employed conjointly with the central blast.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

2605. L. P. La Ciotat, France, "An improved anti-saline coating, chiefly applicable for preserving from corrosion and incrustation the boilers and pipes of marine steam engines."—Oct. 21, 1864.

2684. B. R. Keith, Ingram Court, London, "A new article of farinaceous food." A communication from J. Candler, Boston, U.S.A.—Oct. 29, 1864.

2073. J. Ramsbottom, Crewe, Cheshire, "Improvements in the manufacture of steel and iron, and in the apparatus employed therein."

3075. E. Brooke, the younger, Huddersfield, Yorkshire, "An improvement in the manufacture of glass-house pots."—Dec. 12, 1864.

3116. J. Ellis, North Ormesby, Yorkshire, "Improvements in furnaces used in the manufacture and the heating and melting of iron, which improvements are also applicable to other furnaces."—Dec. 16, 1864.

3191. J. Paterson, Dundee, N.B., "Improvements in the treatment of jute and other fibrous substances, and in the machinery, apparatus, or means connected therewith."—Dec. 19, 1864.

3214. H. Hicklin, Wollaston, Worcestershire, and

Parade, Brierly Hill, Staffordshire. "Improvements in the construction of coke ovens."—Dec. 27, 1864.

3221. J. Cleaver, Canterbury Place, Walworth, Surrey. "Improvements in the manufacture of Portland cement."

3222. J. R. Breckon, Darlington, Durham, and R. Dixon, Crook, Durham. "Improvements in the construction of coke ovens."—Dec. 28, 1864.

3245. A. S. Macrae, and A. Bayley, Liverpool, Lancashire. "Improvements in the burners of hydrocarbon fluid lamps."—Dec. 30, 1864.

5. J. F. Parkes and J. Tanner, Birmingham. "Improvements in the manufacture of oxygen gas, and in treating and economising the residual products of the said manufacture."

9. Robert Irvine, Musselburgh, N.B. "Improvements in treating the pitch obtained in, or resulting from, the distillation of palm oil and other fats in candle-making."—Jan. 2, 1865.

15. L. D'Aubreville, Paris, France. "Improvements in manufacturing paper." A communication from J. J. Mancey, Fures, département de l'Isère, France.—Jan. 3, 1865.

#### NOTICES TO PROCEED.

2105. C. G. Lundborg, Sodertelje, Sweden, "An improved mode of extracting oils from coal or other bituminous substances yielding hydro-carbon oils."—Aug. 26, 1864.

2116. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, France, "Certain improvements in the manufacture of artificial stone."—A communication from C. Pasquin, Verdun, France.—Aug. 27, 1864.

2132. A. Smith, Hackney, Middlesex, "Improvements in machinery for applying paste and other liquid adhesive material colour and paint to paper and other substances."—Aug. 30, 1864.

2156. J. F. P. Hugouneuf, Lodève, Département de l'Hérault, France, "An improved method of obtaining indigo from textile materials, either yarns or fabrics, previously dyed by the blue soaking process."

2157. W. L. Duncan, Hunter Street, Brunswick Square, Middlesex, and S. C. Child, The Grove, Clapham, Surrey, "Improvements in bleaching coloured and other rags or other materials, or half stuff, and in rag engines for paper making."—Sept. 2, 1864.

2177. D. Walker, Liverpool, "Improvements in arrangements for malting."

2178. T. H. Baker and T. Woodroffe, Tunbridge, Kent, "Improvements in filtering apparatus for filtering water and other liquids."—Sept. 6, 1864.

2385. N. Thompson, Abbey Gardens, St. John's Wood, Middlesex, "Improvements in stoppers for bottles and other vessels."—Sept. 28, 1864.

3049. A. D. Hall, Glasgow, Lanarkshire, N.B., "An improved compound for coating the bottoms of ships and structures wholly or partially immersed in the sea or tidal estuaries, and in the system or mode of preparing the same."—Dec. 7, 1864.

#### CORRESPONDENCE.

##### Continental Science.

PARIS, January 19.

FANCY a number of people at work by lamp-light around a table two yards in diameter, at what height should the flame of the lamp be placed to give the maximum of light at what we may call the working distance on the table—say half a yard from the circumference? This is a question which M. Breton, of Grenoble, has set himself to solve; and I give your readers the benefit of his solution. I have given a rough approximation of his French measures to



save you trouble. Well, M. Breton states that the height should be equal to seven-tenths of the radius of the circle, but it may be raised to the whole radius, or brought down to half without making much difference. But at greater distances the loss of light at the working distance is very considerable. The author has gone further, and applied his investigations to street-lighting, deciding at what height gas lamps should be placed to light up extended distances. The same rule as above applies in this case. The height of the jet should be seven-tenths, or about two-thirds of half the distance between two lamps. This would in most cases give us inconveniently tall lamp-posts; but M. Breton here makes a suggestion which may deserve some attention. He recommends that a greater number of smaller jets should be employed, and the lamps be placed nearer together. Supposing, for example, that the amount of gas consumed in one jet be divided between three smaller burners placed at thirds of the space between two taller lamps; the intensity of each light will now, he says, be three times less, but the squares of the distances will also be three times less, and consequently there will be three times the amount of useful light for the same consumption of gas. These notions, as I have said, may deserve the attention of those who are concerned in the lighting of London streets, which, it must be admitted, is open to improvement. M. Breton recommends the electric light for street illumination—not one intense, but a number of small ones, such as the miner's lamp invented by M. Dumas, of Privas. This is a small lamp, giving about the light of one candle, which the miner can carry on his back. The current is not passed from carbon points, but is carried into a sort of electric egg, a glass flask partially exhausted of air. These give a very soft light, and are capable, M. Breton thinks, of modification for the lighting of public ways. They may be, perhaps, when we have discovered a cheap source of the electric force.

An ingenious thought has also struck M. Agudio, who proposes to cleanse the streets with a pneumatic machine. He has invented a mud-cart, consisting of a close iron box, from which the air is pumped by a small engine on the top. Some machinery behind, as the cart moves on, sweeps or rakes the mud together, which is, of course, sucked up by a tube dipping into it, and brought from the upper part of the cart box.

To count the grains of sand on the sea-shore has generally been considered a tedious, if not an impossible operation. Similarly, it might be supposed a difficult matter to count the drops in a shower of rain. M. Herve Mangon, however, proposes to do this in a very simple way. For this purpose he impregnates a paper screen with sulphate of iron, and faces it with a mixture of very finely-powdered nutgall and gum sandarac. Drops of water falling on this screen will make a black spot. If now the screen be placed on a drum which makes a complete revolution in twenty-four hours, successively exposing parts of the screen to the rain, the duration of the shower and the number of drops will be clearly indicated by the black spots; and the time, the space of paper exposed at each moment, and the area covered by the shower being known, the rest becomes a simple arithmetical operation. The apparatus can also be arranged to show the direction of the fall, and also, it is said, to determine the weight of the drops.

I will just mention, for as much as it is worth, a discovery made by a M. Mace, who calls himself a professor of chemistry. He says that he has obtained a very cheap illuminating agent, an oil having the formula  $C_7H_7O_9$ , and the density 1.09, by distilling the kernels of the little cherry fruit of *Cerasus avium* used in the preparation of Kirschenwasser. The oil costs, he says, from 55 to 60 centimes per litre, and a litre will supply a lamp giving the light of two gas jets for twenty-three or twenty-four hours.

#### Dr. Hofmann's Exhibition Report.

To the Editor of the CHEMICAL NEWS.

SIR,—My attention has been called to an article in the CHEMICAL NEWS of the week before last relating to the publication of the jury reports of the Exhibition of 1862. As it appears based on a misapprehension of the facts, and my name is quoted in it, may I beg the favour of your permitting me to offer a correction?

The Commissioners of the Exhibition of 1862 had nothing whatever to do with the publication—indeed, it was in consequence of the Commissioners, for reasons unnecessary here to enter upon, determining not to issue any jury reports, that the Society of Arts, who had originated the Exhibition, and obtained from the Crown the Charter incorporating the Commissioners, and who felt the importance of securing an authentic record of it, resolved to publish jury reports at its own expense and risk, if the jurors would undertake the task of furnishing the reports. The arrangement was made and the work advertised at 15s. the volume to the public, the members of the Society of Arts, and those connected with the Exhibition being permitted to subscribe for copies at 10s. The original intention was to bring out the volume before the close of the Exhibition, but owing to the difficulty of getting the MSS. of the reports from the jurors completed in time, this was found impossible, and it was determined to issue to the subscribers and sell separately in the building and elsewhere such of the reports as were ready. This was done, and the sale of those and other reports as they were completed was kept on until the whole were complete and the volume issued. The chemical report which is referred to in the CHEMICAL NEWS was the last or nearly the last that was completed, Dr. Hofmann being determined to make it as perfect as possible, and sparing no time or pains to effect the object.

On the completion of the volume the reports were no longer sold separately, and hence no separate copies of this report, as well as of some others furnished contemporaneously, were on sale. A sufficient number of reports were printed to complete subscribers' sets, and an edition of the complete volume was printed for sale to the public as large as was thought justifiable on the part of the Society to publish, it not being a trader who might speculate on retaining a remainder stock.

The edition is now exhausted, but I think I may venture to say that if a sufficient number of subscribers were guaranteed the Council of the Society of Arts would be ready to reprint the whole or any one of the jury reports that might be desired.

The Society of Arts in bringing out the jury reports involved itself in a considerable pecuniary loss, but it was considered a public duty to undertake the publication, and a legitimate and proper application of its funds.

I am, &c. P. LE NEVE FOSTER.

Society of Arts, Manufactures, and Commerce, Adelphi,  
London, W.C., January 17.

P.S.—I may add that Her Majesty's Commissioners subscribed for a large number of copies, which were presented to foreign governments, commissioners, jurors, and others.

#### Alcohol from Apples.

To the Editor of the CHEMICAL NEWS.

SIR,—Last spring I made some experiments on windfalls from apple trees, with a view of utilising them by making spirit from them. This would probably be found a more economical application of using them than using them for feeding pigs, as is done now, for pigs will eat anything; they eat coals with great relish.\*—I am, &c.

ARTHUR REYNOLDS, B.Sc.

\* Would our correspondent consider carbon taken in this form as respiratory food?—ED.



*Revivification of Animal Charcoal.*

To the Editor of the CHEMICAL NEWS.

SIR,—My attention has been called to your notice of Mr. Beanes' patent for "treating animal charcoal" in your number dated January 7. As the writer has, to some extent, misapprehended the object of the patented process, I beg you will allow me, on behalf of my friend and co-adjutor, Mr. Beanes, to give to your readers an explanation.

Early last year Mr. Beanes patented a process for removing the lime and carbonate of lime from the animal charcoal used in sugar refineries, by treating the dry black with dry hydrochloric acid gas, and subsequently washing out the chloride of calcium. On May 4 he patented the use of the materials named in the specification you refer to, and which answered to some extent; but, finding the dry hydrochloric acid gas to be not only much cheaper, but far more efficacious, he abandoned the second patent, considering it of little or no value.

Every ton of raw sugar refined in England contains from 7 to 10 lbs of lime, the remains of that which has been used in the country of production to neutralise the acids of the cane-juice. It is this lime which chokes up the pores of the animal charcoal, and renders it inefficacious as a decoloriser. The removal of this lime from the spent charcoal has hitherto been to the refiner an insurmountable difficulty, but Mr. Beanes, who has had more than twenty-five years' experience in the sugar plantations of Cuba, has, for some years past, devoted his great chemical and scientific knowledge to the solution of the problem. How far he has succeeded in removing the lime and carbonate of lime, without attacking the phosphate, and so injuring the bony structure of the charcoal, is best proved by the fact that the largest sugar refinery in New York—that of Messrs. Havemeyer and Elder—have been using the process for six months, and they effect not only a saving of 100 per cent. of charcoal, but they get a larger produce of sugar, and of a finer quality. I am, &c.

HY. MEDLOCK.

Chemical Laboratory, 20, Great Marlborough Street, W.

*Destruction of Parasites.*

To the Editor of the CHEMICAL NEWS.

SIR,—Noticing in the CHEMICAL NEWS for January 7 a reference to petroleum as destructive to parasites on the human body, I desire to say that my attention has been for a considerable period directed to the application of chromic acid or bichromate of potash for the same object, having applied it to ringworms and every other skin disease with complete success, and having also applied this acid to animals, especially to cows' feet, with the same satisfactory results. In preparing the solution, I use one ounce of bichromate dissolved in six ounces of water, then apply the solution to the place affected, one dressing generally being sufficient. I may remark that this solution should not be used too often, because by its repeated application the caustic effects of the acid will cause a wound. But this is not at all dangerous. My experience in the application of this acid has been very long, and I never found it to fail in destroying parasites.

I am, &c. ISRAEL SWINDELLS,  
Scientific and Analytical Chemist.

Lansdown Terrace, Wigan.

*Purification of Oil of Bitter Almonds.*

To the Editor of the CHEMICAL NEWS.

SIR,—I should feel obliged if you would permit me to set right one or two little errors that have crept into your report of the meeting at the Pharmaceutical Society on the 4th inst.

In the first place, I did not bring forward the formation of a compound of the benzoic aldehyd with bisulphite of

sodium as a new chemical fact, but merely suggested its application to the purification of crude oil of almonds.

You say afterwards that "Mr. Tilden remarked that the hydrocyanic acid did not exist in the oil as a cyanide. It was probably furnished by benzamide." I believe the substance of my observation was this: that the hydrocyanic acid, which makes its reappearance in certain specimens of the essential oil purified in the ordinary way, might not exist there in the form of a cyanide, but would more probably result from the splitting up of such a body as the so-called "benzimid." 
$$\text{C}_{46}\text{H}_{18}\text{K}_2\text{O}_4 + \text{H}_2\text{O}_2 = 3\text{C}_{14}\text{H}_6\text{O}_2 + 2\text{HC}_2\text{N}.$$

I am, &c.

WILLIAM A. TILDEN.

17, Bloomsbury Square, January 17, 1865.

*Water Analyses.*

To the Editor of the CHEMICAL NEWS.

SIR,—I observe in the last number of the CHEMICAL NEWS an analysis of the Llandudno water, by Dr. Muspratt, in which silicate of soda is given as one of the ingredients. This appears to me to be a mistake, as the presence of chloride of magnesium and some of the other substances set forth in the analyses would be incompatible with the existence of silicate of soda.

I have been induced to notice this, as what I consider the same error occurs in an analysis of Moffat water by Dr. John McAdam.

I am, &c.,

ALEX. WHITELOW.

55, Sidney Street, Glasgow.

MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday and Thursday, January 24 and 26, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, January 27, at 8 o'clock, General Sir H. Rawlinson, K.C.B., "On the Results of Cuneiform Writing to the Present Time." Saturday, January 28, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System in Man and Animals."

**Simpson v. Holliday.**—On Saturday last the Lord Chancellor gave his decision in this case, reversing the judgment of Vice-Chancellor Wood, and declaring Medlock's patent invalid. The Lord Chancellor said it had been asserted that the dye in question was capable of being manufactured by a double process—hot as well as cold—and the question appeared in truth to turn on that. He was of opinion that, as far as that was concerned, the specification was untrue; but as there was a probability of the case being carried to the House of Lords, he would simply reverse the order made by the Vice-Chancellor, and dissolve the injunction. The patent was null and void, but he would not dispose of the other issues raised upon the trial, because the consequences of the opinion as to the patent were obvious. Of course, where there was no patent there could be no infringement; but in the event of the House of Lords reversing his Lordship's decision, then the question of infringement would be tried. This celebrated case is a notable illustration of the "glorious uncertainty" of the law, and also of need of a proper tribunal for the trial of such actions.

**Thermometer Alarm.**—M. Morin has devised an instrument which may be susceptible of many useful applications. A green-house, for example, must be kept at an uniform temperature, but it may not be convenient to keep a man to continually observe the thermometer, and attend to the fire. M. Morin has therefore contrived an instrument which will give notice whenever the temperature of the conservatory falls below the desirable point. It consists of an ordinary thermometer, into the bulb of which a platinum wire is carried, another being



brought through the top down to the point marking the degree of heat required. These wires are placed in connection with a small battery and an electric alarm. It will now be seen that as long as temperature is maintained the circuit is complete, but as soon as the mercury falls below the platinum wire the circuit is broken, and a small electro magnet lets fall an armature, which completes a circuit with the alarm. This now begins to ring, and continues to do so until the temperature rises again to the proper height. Different adaptations of this instrument may make it useful in giving indications of changes of temperature in many industrial operations.—*Comptes Rendus*.

**Revision of the Medical Act.**—It is said, on something like authority, the Medical Council are engaged on a revision of the Medical Act, with the view of bringing an amended bill before Parliament in the ensuing session. We make the announcement now, that those of our readers interested may be on the alert. On a future occasion we shall probably make some remarks on the subject.

**Irish Metallurgical and Chemical Manufactures.**—The absence from Ireland of any abundant deposits of bituminous coal such as occur in this island, and on which gift of nature has been built up the colossal fabric of England's industrial power, necessarily prevents the establishment in that country of those branches of trade in which the cost of fuel forms any very large proportion of the total cost of production. Hence, although possessing in abundance deposits of the richest iron ores, we have not had any successful establishment of iron smelting in recent times. The iron ores, however, both as earthy carbonate and as hematite, are now largely exported from Ireland to this country to supply the enormously increased demand. Similarly, although large quantities of copper ore are raised in Ireland, principally in the southern counties of Cork and Waterford, the ore is shipped to Swansea to be smelted, as the large proportion of fuel which is required in smelting copper would render the progress in Ireland too costly to be profitably carried on. In the case of the ores of lead and silver, however, the proportion of fuel necessary is not so large, and not merely are all the lead and silver ores raised in Ireland smelted in the vicinity of Dublin, but a large quantity of foreign ores of those metals are imported for Irish smelting works, the produce from which is highly esteemed, not merely in the local but in the British markets. I believe that this department of mineral industry will be found very efficiently represented by Irish smelters in the coming Exhibition. Although the smelting of iron ores and the actual manufacture of iron is not now carried on in Ireland, yet there is a very large amount of trade in the making of machinery, especially for the linen manufacture, of steam engines and water-wheels, and of late years of iron ships. This latter business has already assumed large proportions. A very large branch of mining industry in Ireland, that of iron pyrites or sulphur ore, becomes the basis of an extensive series of chemical manufactures, which, however, are limited, just as in the case of iron smelting to those branches in which the cost of fuel does not form a preponderant proportion of the total cost of manufacture. In Dublin, Cork, and Belfast, large quantities of sulphuric acid, of chloride of lime, sulphate of soda, &c., are made; the important branch of alkali making, as caustic and carbonate of soda, however, is not, as I believe, carried in Ireland beyond the manufactures of sulphate of soda.—*Sir R. Kane's Lecture*.

**The Odour of Flowers, and the Enfleurage Process.**—The odours of flowers do not, as a general rule, exist in them as a store or in a gland, but they are developed as an exhalation. While the flower breathes it yields fragrance, but kill the flower, and fragrance

ceases. It has not been ascertained when the discovery was made of condensing, as it were, the breath of the flower during life; what we know now is, that if a living flower be placed near to butter grease, animal fat, or oil, these bodies absorb the odour given off by the blossom, and in turn themselves become fragrant. If we spread fresh unsalted butter upon the inside of two dessert-plates, and then fill one of the plates with gathered fragrant blossoms of clematis, covering them over with the second greased plate, we shall find that after twenty-four hours the grease has become fragrant. The blossoms, though separated from the parent stem, do not die for some time, but live and exhale odour, which is absorbed by the fat. To remove the odour from the fat, the fat must be scraped off the plates and put into alcohol; the odour then leaves the grease and enters into the spirit, which thus becomes "scent," and the grease again becomes odourless. The flower farmers of the Var follow precisely this method on a very large scale, with but little practical variation, with the following flowers: rose, orange, acacia, violet, jasmine, tuberose, and jonquil. The process is termed, as said before, *enfleurage* or in-flowering. In the valley of the Var there are acres of jasmine, of tuberose, of violets, and the other flowers named. In due season the air is laden with fragrance—the flower harvest is at hand. Women and children gather the blossoms, which they place in little panniers like fishermen's baskets hung over the shoulders. They are then carried to the laboratory of flowers and weighed. In the laboratory the harvest of flowers has been anticipated. During the previous winter great quantities of grease, lard, and beef-suet have been collected, melted, washed, and clarified. The great success of this process depends on the absolute purity of the grease employed, and no pains are spared to this end. In each laboratory there are several thousand *chassis* (sashes), or framed glasses, upon which the grease to be scented is spread, and upon this grease the blossoms are sprinkled or laid. The *chasse en verre* is, in fact, a frame with a glass in it as near as possible like a window-sash, only that the frame is two inches thicker, so that when one *chasse* is placed on another, there is a space of four inches between every two glasses, thus allowing room for blossoms. Every *chasse*, or sash, is about two feet long by eighteen inches broad. The flower blossoms are changed every day, or every other day, as is convenient to the general work of the laboratory or flowering of the plants. The same grease, however, remains in the *chasse* so long as the particular plant being used yields blossoms. Each time the flowers are put on, the grease is "worked"—that is, serrated with a knife—so as to offer a fresh surface of grease to absorb odour. The grease being inflored in this way for three weeks or more—in fact, so long as the plants produce blossoms, is at last scraped off the *chasse*, melted, strained, and poured into tin canisters.—*Dr. Piesse's Lecture*.

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

X.—*Annal. de Chim. et de Physique*, 3, 195, and *Journ. fur Chem.* 25, 401.

*Currier*.—Vol. X. of the CHEMICAL NEWS, just completed, contains the Cantor Lectures, "On Chemistry Applied to the Arts," delivered at the Society of Arts, by Dr. F. C. Calvert.

*Chem*.—The last traces of carbonaceous matter may be got rid of by the addition of a little dry nitrate of ammonia, but you must add it carefully and in small quantity, or some of the contents of the crucible may be projected.

*Received*.—C. J. Richardson; Holidays.

*Books Received*.—"American Journal of Pharmacy;" "The Philadelphia Photographer."

\* \* Will our American correspondents kindly take care to properly affix the stamps, which, we presume, originally accompany the journals they send us?



## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

### PART I.

#### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

##### SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

BODIES combine in definite proportions; this is one of the fundamental truths of chemistry. The notions of equivalents, of atomic weights, and of molecular weights are a consequence of it, and the idea of regarding chemical compounds as molecules formed of a juxtaposition of atoms is its theoretical representation. These ideas are involved in all that appertains to chemistry, and are the basis of all discussions connected with the science. It is important, therefore, to look for their origin and development, and to examine how, from being for a long time ill defined and confused, they have ultimately assumed the definite forms which they now possess.

**Definite Proportions.—Equivalents.**—The ideas of definite proportions have become introduced into science by researches into the composition of salts. It was found that in order to saturate a definite weight of alkali with an acid of known strength, it was necessary to employ an invariable weight of the latter; and it was observed that the formation of a neutral salt depended upon the existence of a fixed relation between the amounts of real alkali and acid present, the least excess of one or the other being sufficient to destroy the neutrality.

In 1699 Homberg\* undertook some experiments on this point which deserve to be mentioned. He found that 1 ounce of salt of tartar (carbonate of potash) required to saturate it,—

14 ounces of the best vinegar.

2 ounces 3 drachms of spirit of salt (hydrochloric acid).

1 ounce, 2 drachms, 36 grains of aquafortis (nitric acid).

5 drachms of vitriolic acid.

After evaporating the saturated liquids the increase in weight of the solid matter was,—

3 drms. 36 grs., after saturation with vinegar.

3 " 14 " " " hydrochloric acid.

3 " 36 " " " nitric acid.

3 " 6 " " " sulphuric acid.

It is seen that these experiments have for their object the determination of the quantities of different acids which are required to saturate the same weight of base. Inaccurate as are their results, they amount to an attempt, crude, indeed, but the earliest, to determine what we to-day call the equivalents of acids.

Nearly a century elapsed before the question of the composition of neutral salts, started by Homberg, received a satisfactory solution. Bergmann and Kirwan examined it with but moderate success, and it is somewhat remarkable that it was reserved for one of the last upholders of alchemy—Wenzel†—to settle this point.

The work written by this chemist in 1777, under the title of "Vorlesungen über die Chemische Verwandtschaft

der Körper" (Lessons on the Chemical Affinity of Bodies), is even now remarkable for the accuracy of the analyses there described, and for the justness of the conclusions which the author knew how to deduce from them. The starting point of these researches was the following phenomenon, which was then well known, and which had already been observed by chemists:—

When concentrated and neutral solutions of sulphate of potash and nitrate of lime are mixed together, there are formed, by double decomposition, sulphate of lime which is precipitated, and nitrate of potash which remains in solution. The two newly formed salts are neutral, like the former, and it is the permanency of this neutrality which requires explanation.

Wenzel found this explanation in the composition of the four salts under examination. Having analysed the nitrate of lime, he found that 363 parts of this salt contained 123 parts of lime and 240 parts of nitric acid. He then tried how much sulphate of potash he should have to take for the lime to be completely precipitated by the sulphuric acid. Experiment had shown him that 162.5 parts of lime neutralised 240 parts of sulphuric acid, and he concluded from this that 123 parts of lime ought to require 181.5 parts of sulphuric acid.

On the other hand, he found that 240 parts of sulphuric acid required for neutralisation 290.4 of potash; 181.5 of sulphuric acid should therefore require 220 parts of potash; and to completely precipitate the lime from 363 parts of nitrate of lime it would be necessary to take 181.5 + 220, or 401.5 parts of sulphate of potash.

The 304.5 parts of sulphate of lime (containing 123 parts of lime and 181.5 parts of sulphuric acid) being precipitated, Wenzel concluded that the 240 parts of nitric acid originally combined with 123 parts of lime, ought, in order to form a neutral salt, to unite with the 220 parts of potash originally combined with the 181.5 parts of sulphuric acid. An analysis of nitrate of potash proved that his conclusion was correct; for he showed experimentally that 240 parts of nitric acid united with 222 $\frac{2}{3}$  parts of potash, an amount differing very little from 220.†

The important deduction from these researches is this: when nitrate of lime and sulphate of potash are mixed together in such proportions that the lime of the first salt will be neutralised by the sulphuric acid of the second, the nitric acid left by the lime is *precisely the amount* necessary to neutralise the potash abandoned by the sulphuric acid.

In other words, when two neutral salts mutually decompose each other, the neutrality is maintained for the reason that the amount of base which is neutralised by a certain weight of one acid, is also neutralised by a definite weight of another acid.

Hence arises the idea of equivalency. We have here two acids and two bases. The same quantities of each base neutralise successively a given weight of each acid, and are consequently *equivalent* to each other; thus:—

123 parts of lime } neutralise successively  
222 parts of potash } 240 parts of nitric acid,

and are, consequently, equivalent in relation to this weight of nitric acid.

123 parts of lime } neutralise also 181.5 parts  
222 parts of potash } of sulphuric acid.

† 363 parts of nitrate of lime contain 123.9 of lime and 239.1 of nitric acid; these figures are almost identical with the figures 123 and 240 obtained in Wenzel's analysis.

401.5 parts of sulphate of potash contain 184.5 parts of sulphuric acid and 217 of potash. Wenzel found in it 181.5 of sulphuric acid and 220 of potash. A comparison of these numbers will give a good idea of the accuracy of his analyses.

\* Hermann Kopp, *Geschichte der Chemie*, ii., 355.

† Charles Frederick Wenzel was born at Dresden in 1740 and died in 1793, being at that time the director of the famous mines of Freiberg, in Saxony. He published in 1773 a work entitled "An Introduction to the Higher Chemistry" (Einleitung zur Höheren Chemie) and devoted it to the defence of alchemical ideas.



and are, therefore, equivalent in respect to this weight of sulphuric acid.

It suffices, therefore, to determine the proportions in which two bases combine with an acid to know also the proportions in which these bases will unite with another acid.

In these memorable experiments it was necessary to determine the composition of nitrate of lime, and that of sulphate of potash, also to find what quantity of sulphuric acid was necessary to saturate the lime in the nitrate, and then to know how much nitric acid was necessary to saturate the potash in the sulphate. The composition of nitrate of potash was then foreseen by theory: 240 parts of nitric acid required 220 of potash. This is the amount predicted theoretically; 222.5 is the experimental quantity. Thus, Wenzel not only introduced into chemistry the idea of equivalency, but, at the same time, he foresaw and predicted the conclusions that could be drawn from it respecting the theoretical calculation of the composition of salts and the control of analyses.

Researches so exact and so important were scarcely noticed by chemists at that time, and were soon quite forgotten. The time for Wenzel had not yet arrived; his contemporaries were discussing theoretical ideas of a higher order; every one was excited by the teachings and astonishing discoveries of Lavoisier.

(To be continued.)

### *On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, F.C.S.*

(Continued from Vol. x., page 210.)

**10. Robert Hooke.**—Robert Hooke was born in 1635; in 1653 he went to Oxford, where he made the acquaintance of Boyle, who was so struck with his aptitude for devising experiments and constructing apparatus that he engaged him as his assistant; and these two greatest experimental philosophers of the age immediately succeeding that of Bacon worked together for several years on numerous branches of science. Hooke was a man of great erudition—his writings relate to all the physical sciences known at the period; he excelled greatly as a mechanic, and his inventions are said to number more than a hundred; among others we may mention the circular pendulum, the wheel barometer, and instruments to graduate thermometers, to measure time with exactness, to determine the refractive power of liquids, to grind optical glasses, and to show the number of vibrations of a string requisite to produce a certain note; moreover, he greatly improved the microscope and telescope.

Hooke's first scientific treatise\* was published in 1661; in it he endeavoured to explain the cause of some effects observed by Boyle, as to the rise of water in tubes of small diameter. It was the ingenuity of this treatise which first brought Hooke before the notice of the recently formed Royal Society, and it was immediately proposed that he should be requested to act as curator to the Society. To this office he was elected on November 12, 1662, and it was ordered that he should be required to show "three or four considerable experiments" whenever the Society met; a vote of thanks was passed to

Boyle for dispensing with the services of so valuable an assistant.

At the following meeting (November 19) Hooke showed some experiments to prove the weight of air. A globe of glass, the interior of which communicated with the air by a tube of small diameter, was heated to bright redness, and sealed before the blowpipe; when cool it was placed in the scale of a balance, and counterpoised by weights in the opposite scale; on now breaking off the end of the tube so as to admit air to the globe, the latter preponderated. Into a similar globe a small quantity of water was introduced, which was completely evaporated, the globe heated to redness, sealed before the blowpipe, and counterpoised as in the previous experiment; on admitting air the globe preponderated, and the weight of air which had entered was shown by placing weights on the opposite scale, until equilibrium was restored. On December 3 he varied the experiment: two small glass globes one and a-half inch in diameter were sealed at the ordinary temperature, and suspended from one end of the beam of a balance in such a way that the globes preponderated; the balance was introduced into an air-tight vessel into which air was condensed, the globes now ceased to preponderate; on allowing the condensed air to escape from the vessel, the globes returned to their former position.

In 1664 Hooke presented the manuscript of his "Micrographia"† to the Royal Society, and the President, by an order dated November 23, 1664, ordered it immediately to be printed. The "Micrographia" is chiefly devoted to the description of microscopic bodies, but it also contains a great amount of experimental observation in various branches of natural philosophy, particularly in optics; it is in every way worthy to be among the first works published by a Society instituted for the purpose of investigating natural phenomena by experiment.

In the preface Hooke describes the wheel barometer which he had recently devised for showing minute changes in the pressure of the air; the circle was divided into 200 parts, but there were no indications upon it to show what kind of weather might be expected when the index stood at a certain point. From a number of observations Hooke found that the mercury invariably fell before rainy weather, and that it rose before dry weather and during the prevalence of an easterly wind.

The air, according to Hooke, is a mixture of terrestrial and aqueous particles, "dissolved and agitated by the ether;" and just in the same way that a few grains of salt may be diffused through a large quantity of water, so, he says, a small quantity of air may expand and diffuse itself through a large space; on the other hand, as a small quantity of water is able to dissolve a quantity of salt which could diffuse itself through a large quantity of water, so a quantity of air which could expand and diffuse itself through a large space may be contained within a small compass.

In the 7th observation of the "Micrographia" Hooke describes the spirit thermometer, which he introduced into England, and which had been invented a few years previously by one of the members of the Accademia del Cimento, Hooke constructed thermometers of such delicacy that although the stem was four feet long the spirit rose nearly to the top of the tube in summer, and sunk nearly to the bulb in winter:—The freezing point of water was the zero of the scale.

\* This treatise extends over fifty small pages; it is entitled "An attempt for the explication of the phenomena observable in an experiment published by the Hon. Robert Boyle, in the 35th experiment of his epistolical discourse touching the air. In confirmation of a former conjecture made by R. H." London: 1661. Hooke re-published this treatise four years later in the "Micrographia." (Obs. 6, "Of small glass canes.")

† "Micrographia, or some Physiological Descriptions of Minute Bodies made by Magnifying Glasses." London. 1665.



Observation 9 is entitled, "of the fiery sparks struck off from a flint or steel." It was anciently believed that when flint and steel are struck together sparks are produced by the attrition of the air; Lucretius supposed that lightning is produced by the collision of two clouds, in the same way that sparks are produced by the collision of flint and steel. Bacon† mentions that the sparks descend, and when extinguished are found to be a kind of "dark ash;" he affirms, moreover, that they are in reality particles struck off from the flint or steel, raised to ignition by the violence of the friction. Des Cartes endeavoured to explain the production of the sparks according to his three-element theory,§ and in so doing gave a most obscure and unphilosophical explanation; this induced Hooke to examine the phenomenon for himself. Accordingly he collected a number of the particles which had appeared as sparks of fire when first struck off from the steel, and examined them under the microscope; they were then seen to be spheres with a metallic lustre, so bright that bodies could be seen reflected in them. The sparks are, therefore, he contends, minute particles of steel which by the violence of the friction are raised to a red heat, and then take fire and burn, because "there seems to be a very combustible sulphureous body in iron or steel, which the air very readily preys upon, as soon as the body is a little violently heated."

(To be continued.)

## TECHNICAL CHEMISTRY.

*On the Use of Petroleum as Steam Fuel, by*  
C. J. RICHARDSON.

As the patentee of the mode for burning petroleum as steam fuel, now being experimented upon at Woolwich Dockyard, permit me to reply to the article by Mr. Paul, which appeared in the CHEMICAL NEWS of December 17 last.

The relative heating powers of petroleum and coal as depending upon their chemical composition is not the question; the ability of each to create steam is the real matter to be considered.

Petroleum as steam fuel can be very nearly fully utilised; it produces no ash, submits to mechanical management, and makes little or no smoke, does not require any strong draught or current of air like coal, which will

† "Novum Organum," Book 2, Aph. 12.

§ The basis of the physical philosophy of Des Cartes is the hypothesis that all matter consisted originally of square particles, which at the creation were endowed with two motions—the one causing each particle to revolve separately, the other causing groups of particles to revolve around a common centre. The particles during their revolution gradually had their angles worn down by the frequent friction, and thus three elements were produced. The first element, of which the sun, stars, and fire are composed, is the dust produced by the abrasion of the angles; the second, which constitutes the atmosphere, and all the matter between the earth and the stars consists of the spheres which remain when the angles of the original square particles have been worn perfectly smooth; and the third, of which the earth and all terrestrial bodies are composed, consists of the particles which are neither spherical nor square, but which are partly worn smooth and partly have their angles remaining.

The following is the explanation which Des Cartes gives of the production of sparks by the collision of flint and steel:—" . . . consideremus primo varios modos quibus ignis generatur. . . . Nihil usitatius est, quam ut ex silicibus ignis excutitur; hoc quæ ex eo fieri existimo, quod silices sint satis duri et rigidi, simulque satis friabiles, ex hoc enim quod sint duri et rigidi, si percutiantur ab aliquo corpore etiam duro, spatia quæ multus eorum particulas interjacent, et a globulis secundi elementi solent occupari, solito fiunt angustiora, et ideo isti globuli exsilire coacti, nihil præter solam materiam primi elementi circa illas relinquunt; deinde ex eo quod sint friabiles, simul ac istæ silicum particule non amplius ictu premuntur, ab invicem dissiliunt, sicque materiæ primi elementi, quæ sola circa ipsas reperitur, innatantes ignem componunt."—"Principia," Pars quarta, par 84.

not burn without it; and the consequence of which is, a very considerable portion of the fuel is lost as waste heat in the chimney.

In a late work by Mr. Wye Williams, one of our chief authorities on this subject, entitled "On the Steam Generating Power of Marine and Locomotive Boilers," he details three careful experiments as to the best form of boiler to obtain the greatest amount of heat from coal. He gives the temperature of the waste heat in the first experiment as 1060°; to the second, 760°; and the third, 635°—and this, be it observed, with the consumption of only 3½ cwt. of coal to each experiment. I should like to learn the temperature of the waste heat in the chimney of a furnace burning from twenty to thirty tons of coal per day. We know the current is so strong that it often carries up small coal and cinders along with it; that the heated gases often take fire by a spark from the furnace, and burn at the top of the funnel with a fierceness almost equalling the flame from a blast furnace. Is this flame or waste heat employed in creating steam? and how much is the coal utilised? In practice the ratio of the heating power of petroleum and coal is about = 1.4 = 0.4. We shall never learn the wicked waste we are making of our coal until petroleum supersedes it.

The American plan can be seen by inspecting the French patent; it was not likely to be successful; it does not follow that other more simple methods may not succeed.

My grate, which burns petroleum through a porous material, has in every instance, when put under a boiler, proved petroleum to be full five times more powerful than coal for steam purposes—one ton doing as much as five tons of coal. If four tons out of five are saved for freight space, the price of the latter being 7*l.* per ton, the profit on every ton of petroleum would be 14*l.* 15*s.*,—the coal at 15*s.*, the petroleum at 17*l.* per ton.

But a shipowner might not select the American crude at 17*l.*; he would take the Flintshire coal oil, quite as good for his purpose; this is only about 10*l.* per ton.

The average price of coal on a long voyage would be low at 2*l.* per ton. Taking these prices and freights at the reduced sum of 5*l.* per ton in a ship requiring 500 tons of coal, and using instead 100 tons of petroleum, would gain by the exchange 2000*l.* It would not be necessary to start with the full quantity of petroleum, it being more distributed about the earth than coal, obtainable at first cost in the oil countries.

As to the alleged advantage of the oil taking up less room than coal, no notice need be taken of it; a great deal more might be said of the advantage of a ship being able to go from port to port without turning aside for fuel.

Now, as to the highly dangerous, inflammable nature of petroleum, this is in a very great part fudge. If the oil were contained in cast-iron cases securely closed, no vapour could escape; or if the small amount of spirit which produces the inflammable vapour was first extracted, the residue, the burning oil and heavy petroleum, would be no more dangerous than so much lard or spermaceti.

Kensington Square.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday and Thursday, January 31 and February 2, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 3, at 8 o'clock, Professor Odling, F.R.S., "On Aluminium, Ethide, and Methide." Saturday, February 4, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."



## PHARMACY, TOXICOLOGY, &amp;c.

*On a Test for the Resin of Cannabis Indica*, by  
WILLIAM PROCTER, jun.

HAVING accepted the question, "Is there a reliable test for the active resin of *Cannabis sativa* of the East Indies, whereby the genuineness of 'Extract of Indian Hemp' may be satisfactorily and easily ascertained by the pharmacist?" the following paper is offered as a reply:—

It need hardly be said that the extract of Indian hemp is a valuable medicine in the opinion of many practitioners, when prepared from hemp tops that have had their virtues developed by growth in a favourable climate and soil. In East Indian commerce there are three substances derived from the hemp plant—viz., *gunjah*, consisting of the flowers and incipient fruit, with the smaller branches; *bang*, made up of the leaves and capsules without the stalks; and *churrus*, the resinous matter secreted by the hemp plant under favourable circumstances. These have been long known in the East, but the form in which it has been chiefly employed by European and American practitioners is the alcoholic extract of *gunjah*. The variableness in the medicinal power of this extract has been the cause of much disappointment to physicians; for whilst some samples prove effective in half-grain doses, ten or even twenty grains of other specimens have failed to produce its peculiar influence on the nervous system. The extract of commerce varies in consistence and colour. Its green hue is sometimes much darker than at others, and its odour is equally variable in strength. Although professedly an alcoholic extract, much of it is but partially soluble in alcohol of 90 per cent. In a sample of extract, that had been imported several years ago from Mr. Squire, of London, in bulk, as much as 40 per cent. of the preparation was insoluble in stronger alcohol. The undissolved portion was brown, and readily soluble in water. In another sample from the same house in ounce jars, the proportion of aqueous extractive was hardly noticeable. Another sample, the origin of which was not known, and which was quite old, had a solid consistence, almost black colour, and produced powerful effects at the time it was tried therapeutically many years ago. No feature of this extract is more marked than its softness. After a pretty thorough examination of the subject, I believe this to be chiefly due to fixed oil of the hemp seeds, which the tops often contain sufficiently developed to yield oil, and which is, to a greater or less extent, extracted by the spirit, and being miscible with the resin, they remain in close union.

As regards the extractive matter soluble in water, its presence is easily accounted for, either by the use of alcohol weaker than .835, or by following strong alcohol with weaker spirit to displace the former, when the process is carried too far. When officinal alcohol alone is used, it may occur by continuing the boiling process until the percentage of alcohol gets below the standard strength, as will occur with officinal alcohol during continued digestion. Where the proportion of matter insoluble in alcohol is as great as 40 per cent., either error or design must have produced it, as under no ordinary circumstances will hemp yield to alcohol such a product.

In the process of Mr. Robertson, of Calcutta, described by Pereira, in which the vapour of alcohol boiling in a still is conducted into the top of a cask containing the *gunjah*, with an ordinary condensing worm attached to the bottom of the cask, this may also readily occur; as the last portions of vapour from the still will be much

more watery than the first, they will dissolve the extractive and carry it down into the recipient along with the resin, to be mingled with it in the subsequent concentration to the extractive consistence.

M. Gastinel, of Cairo, Egypt, has suggested that the resin should be washed with water to get rid of this extractive.

M. Laneau, of Brussels, after finding that hemp resin is much more soluble in a mixture of alcohol and ether or chloroform than in alcohol alone, recommends the hemp to be exhausted by percolation with such a mixture, which not only dissolves the resin better, but does not dissolve the inert matter.

Messrs. T. and H. Smith, of Edinburgh, who have studied hemp resin closely, have preferred to treat the *gunjah* first with water, and then with solution of carbonate of soda, to remove inert matter soluble in these menstrua, after which the hemp is dried and exhausted with alcohol. The tincture is then treated with milk of lime and filtered, and the dissolved lime separated by sulphuric acid. The treatment by lime is probably intended to remove fixed oils, and any other resinous matter than the active one, should any be present. The tincture is then decolorised by passing it through animal charcoal, evaporated to a syrupy consistence, and precipitated by water and dried. This process produces the pure hemp resin, but is far too tedious to pursue with the extract, which, if wholly soluble in alcohol of 90 per cent., is sufficiently freed from the inert matter of the *gunjah*. To obtain the answer to the query, it became necessary to secure an authentic specimen of hemp extract, which was obtained directly from *gunjah* of good quality.

1000 grains of *gunjah* were reduced to powder, with the exception of the stalks, moistened with half-ounce of alcohol pressed in a funnel, the stalks thrown on the top, and the whole slowly percolated with alcohol of .817 sp. gr. until eight fluid ounces of the tincture had passed; the process was then stopped, and the tincture reduced to an extract by careful evaporation.

The product was soft, of a dark, dull green colour, had the peculiar odour of hemp resin well marked, and weighed 110 grains, equal to 9 per cent.

It had the following properties:—

Soluble without appreciable residue in strong alcohol, ether, and chloroform. Benzole dissolved all but a small residue of blackish green matter, which is wholly soluble in alcohol; and on the evaporation of the benzolic solution, the residue retained its odour and other sensible properties.

Oil of turpentine dissolved it quite readily, and the solution, on standing, became coated with minute scaly crystals, the nature of which was not determined.

Olive oil dissolved it completely, forming a greenish solution, which has been suggested for pharmaceutical use by Laneau and Githens.

Sulphuric acid acts slowly on the resin in the cold, more rapidly hot, without intumescence, and when diluted with water, a greyish precipitate falls.

Nitric acid, sp. gr. 1.38, when cold, slowly attacks the extract, but when heated, rapid reaction occurs, red fumes are evolved, and the resin is converted into an orange-red resinoid substance, about as abundant as the resin treated. This, when washed with water and dried, has the appearance of minute fragments of gamboge, which it closely resembles in colour.

This substance is readily soluble in alcohol, ether, and chloroform, and does not crystallise from these solutions on evaporation; it is also soluble in solutions of potassa



and ammonia and methylic alcohol, but is insoluble in benzole and acetic acid, and appears to possess an acid reaction with litmus.

Liquor potassæ acts but slightly on this extract, apparently removing little besides matter soluble in water, and, perhaps, fatty oil when present, and a part of the green colouring matter.

Of these reactions those best calculated to indicate true hemp resin extract, are:—

- 1st. Its odour when moderately treated.
- 2nd. Its indifference to alkalies.
- 3rd. Its solubility in alcohol, ether, chloroform, benzole, and turpentine; and
- 4th. The reaction of nitric acid, which is the best marked test.

Before trying other resins it was deemed best to procure some American grown hemp, and make an extract from it with the same menstruum. Fortunately, this was easily accomplished, and the tops only of vigorous specimens of the cannabis were selected, dried, and powdered. The colour was deep grass green, the odour rank, but different from gunjah. 300 grains were reduced to powder, and treated with the same alcohol in like proportion as in the preceding experiment, and a soft extract, weighing 37 grains, was obtained.

The colour of this extract was a brighter green, and its odour quite different from the extract of gunjah; it rubbed down readily with liquor potassæ, making a dark coloured liquid, not all in solution. When treated with hot nitric acid, rapid effervescence of nitric oxide followed, leaving a yellowish liquid with a very small proportion of orange-coloured resinoid matter, which appeared to be the same as that from Indian hemp.

It is very clear from these results that the extract of common hemp may be easily detected by its solubility in caustic alkali, and the small portion of resinoid it yields by nitric acid.

1. The extract of Indian hemp before alluded to as being 60 per cent. of resin, was tried by these tests, and the resinuous matter found to correspond with that made from gunjah.

2. Squire's extract in ounce jars afforded a large proportion of resin, which reacted with nitric acid like that obtained from gunjah.

3. A sample from my cabinet, fifteen years old, nearly dry, in dark-greenish black masses. This, when acted on by nitric acid, did not lose its greenish colour, and altogether behaved differently from that made from gunjah.

4. Guaiac resin, treated with nitric acid, first became blue,—afterwards yellowish brown, but yielded no yellow resinoid.

5. Common resin yielded a yellowish resinous product by nitric acid, but entirely different from that obtained from hemp resin: in fact, none of the resins tried have afforded a product similar to that from Indian hemp.

Whatever merit there may be in this test, it must be made more manifest by further experiments, with a series of extracts of known origin and therapeutic powers, so that it may be seen whether the results of testing are parallel with medicinal power; and the attention of members is invited to the subject, that they may, from samples tried by the physicians of their several neighbourhoods, apply these tests, and ascertain their real value or accuracy.—From *Proc. Amer. Pharm. Assoc.*, 1864.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, January 19.

Professor W. A. MILLER, M.D., F.R.S., Vice-President,  
in the Chair.

AFTER the usual business of reading the Minutes and announcing the several donations to the Society's library, the following gentlemen were formally admitted as Fellows, viz.:—Mr. Alexander Y. Stewart, Mr. Thomas Jones, and Mr. J. F. Payne. The name of Mr. John Reid, Trinity College, Cambridge, was read for the first time, and those of the following candidates for the second time, viz.:—Mr. Thomas P. Blunt, B.A., Shrewsbury; Mr. Robert McDonald Bosanquet, Oxford; Mr. Nathaniel Bradley, Prescott; Mr. Charles Eastcourt, Manchester; Mr. Richard Percival, University of Glasgow; Mr. Arthur Smith, Brixton; Mr. Francis Walker, Sidney College, Cambridge; Mr. Thomas H. Windham; and Mr. Arthur Vacher, London. The certificates in favour of Mr. Alfred Noble, Bristol, and Mr. Joseph Carter Bell, Manchester, were read for the third time, and these gentlemen were balloted for and duly elected Fellows of the Society.

The CHAIRMAN said it was proposed to read one or two short papers before proceeding with the adjourned discussion upon Professor Williamson's communication.

Mr. G. B. BUCKTON then gave a concise verbal statement with respect to a specimen of *Boussingaultite* which he exhibited. It was met with in the neighbourhood of the Soffioni of Tuscany, and consisted to the extent of eighty per cent. of sulphate of ammonia.\* Its formation had lately been accomplished artificially by passing a mixture of sulphuretted hydrogen, air, and steam through a heated earthenware tube, when the first named gas became decomposed, the sulphur undergoing oxidation, whilst the nascent hydrogen combines with nitrogen to form ammonia.

Mr. W. H. PERKIN gave a short account of "*The Artificial Formation of Pyridine*," in which he stated that he had obtained this base amongst the products of the action of nascent hydrogen on azodinaphthylamine. He stated that pyridine also appeared to be produced by the action of the same reagent on nitro- and dinitronaphthalene. A nitryl base, probably picoline, he found to be formed by a similar reaction with nitro- and dinitrobenzol.

Mr. C. GREVILLE WILLIAMS said that this observation of Mr. Perkin had for him the greatest interest. It was the first time that quantitative proof had been obtained of the formation of any member of the group, excepting by processes of destructive distillation. He regretted that Dr. Anderson was not present, as he should like to have known whether the bi-pyridine obtained by him by acting with sodium upon pyridine had any relation, save that of isomerism, with the base having twice the formula of pyridine formed by Mr. Perkin simultaneously with pyridine, by the action of nascent hydrogen upon azodinaphthylamine. He also believed, from Mr. Perkin's description, that the pyridine formed artificially by him was identical with that found in Dippel's oil, and was therefore essentially different from the base having the same formula existing among the products of the decomposition of cinchonine by potash. Mr. Williams also stated that about two years ago he found that by cohobating aniline with sodium for a very long time traces of a nitryl base, apparently picoline, were formed, accompanied by a substance which, by contact with hydrate of potassium acquired a brilliant green colour.

\* This natural product appears to be described by Dana (*vide* "System of Mineralogy," fourth edition, Vol. II., p. 379,) under the name of *Mascagnine*, in honour of its discoverer, Professor Mascagni. Its composition is there represented by the formula  $\text{NH}_4\text{O}, \text{SO}_3 + 2\text{HO}$ .

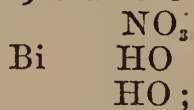


The SECRETARY then read a paper, entitled "*Laboratory Memoranda*," by Mr. ROBERT WARINGTON, jun., of Cirencester. The first part is devoted to an examination of the action of ferricyanide of potassium upon ferric salts, from which the author concludes that the colour (brown or green) produced on mixing these solutions is essentially dependent upon the ratio subsisting between the two salts which are thus brought into contact. If the iron is in excess a bright green colour is formed. The experiments tended to show also that the liquid remains clear only in the event of much free acid being present, and that *basic* ferric salts furnish at once a pale brown precipitate with ferricyanide of potassium. The second part of the author's communication is devoted to the influence exerted by alkaline salts upon the solubility of magnesia and its compounds. It has been found that the chlorides and sulphates of potassium and sodium interfere with the complete precipitation of magnesia by a caustic alkali—an effect attributed to the formation of double salts in a similar manner to that observed in the retardation of magnesium precipitates by the presence of ammoniacal salts.

Mr. NEWLANDS made an objection to the author's statement regarding the action of *basic* ferric salts upon ferricyanide of potassium. It was well known that the excess of ferric oxide existed in these compounds in a colloidal condition, and very trivial circumstances were often sufficient to determine its separation; thus the mere addition of neutral sodium salts, and even acids, occasioned a precipitate, and it was possible that the ferricyanide enjoyed this property in common with other potassium salts. The speaker had lately been in the habit of using the basic ferric chloride or acetate as a reagent for the detection of impurities in distilled water; they were very efficient, since almost any extraneous matter would determine the formation of a precipitate, whilst pure water should remain clear for a long time after such addition.

The CHAIRMAN then invited Professor Williamson to make any further remarks upon the subject of "*Chemical Nomenclature and Notation*," which he might wish to offer before the members proceeded to discuss the points raised in his interesting communication presented at the last meeting.

In answer to this invitation, Professor WILLIAMSON reminded the Society that he desired more particularly the universal adoption of the system of naming compounds and salts according to the method followed in Gmelin's "*Handbook*." Thus, ferric chloride, ferrous sulphate, mercuric oxide, mercurous chloride, &c., would convey to the chemist's mind the clearest possible information regarding these compounds of iron and mercury, and by its use it would be impossible to mistake calomel for corrosive sublimate. Questions might arise in regard to zinc and other metals which formed but one basic oxide; in these cases he would not use any prefix to the name of the metal, but speak simply of "zinc chloride;" but if it were desirable to support an analogy—as, for example, in the case of alumina, with other sesquioxides—he would use the requisite prefix, even though the metal were incapable of forming another oxide. Thus, "aluminic chloride" was a better expression than "aluminium chloride." For double salts this method offered great advantages, and for basic oxides even greater facilities for viewing them, on the original type. The speaker doubted whether it would be possible to find a more concise expression for the basic nitrate of bismuth, commonly so-called, (the old *magisterium bismuthi*) than the formula—



and its constitution would become at once intelligible by calling it "bismuthic dihydronitrate." Also, when a variety of bases are included in one compound, as in microcosmic salt, the "hydammonio-sodic phosphate."

The term "basic" should be reserved for bodies that contained more than one atom of the basylous constituent in one molecule. Thus, plumbic oxychloride,  $\text{Pb}_2\text{Cl}_2\text{O}$ , is a basic salt. With respect to the use of the term "acid," the speaker regretted to notice that his remarks on this head had been, to a certain extent, misinterpreted; at least, he judged so from the tenor of the observations which fell from his friends on the last occasion. It was to him a matter of minor importance whether he was legally entitled to the use of the word "acid" in the sense then advocated, and as being applicable to bodies that do not contain water; and he would impress upon his hearers the advantage of using the term "hydrogen salts" instead of "hydrated acids," particularly in the instruction of beginners; for by this means double decompositions could be explained very simply, and there would be no confusion in the formulæ arising from the conversion of acids into salts. It would be obvious that a scientific system of nomenclature was not suited for ordinary commercial use, and it would be hopeless to attempt to change the designation of such articles as manganese, arsenic, potash, and soda, where the names of the metals are themselves applied to certain oxides, and the alkali made to stand for its carbonate. This consideration need not deter him from recommending the use of the prefixes "ous" and "ic" for bases, as they have been long used for acids, and from offering the various suggestions, which he hoped would be freely discussed.

Dr. DEBUS agreed with the President in the opinion that the appointment of a committee for the discussion of nomenclature would not be attended with any beneficial results. He considered the expression of individual opinion very desirable, and rose, therefore, to ask for explanations upon one or two points. Words are but the signs of conception and operation, and the name conferred upon a body must depend upon our conception of its constitution; and, though this might be liable to change with the progress of intellect and research, it was, nevertheless, incumbent upon us to use now that which is believed to be the correct expression. Quoting from Professor Williamson's published discourse, Dr. Debus wrote upon the board, among other formulæ, the following:—

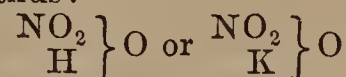


The first of these implied that the hydrogen stood in connection with the highly oxidised body,  $\text{NO}_3$ ; and the last presented an inconsistency, for if



or, in words, the potassic dichromate contained the elements of chromic acid superadded to those of potassic chromate, then the two halves are not of equal value, and the metal chromium is partly united with three, and partly with four of oxygen.

Professor WILLIAMSON at once explained that the formulæ were not used by him as denoting any arrangement of the atoms whatever; he simply grouped them in the most concise possible manner. It might sometimes be convenient to write the formulæ of the hydric and potassic nitrates thus:—



and he would adopt such a course whenever the circumstances seemed to require it.

Dr. FRANKLAND thought the suggestion of Dr. Debus quite worthy of being followed, but such a name would be evanescent from the fact of our views being constantly liable to change. For his own part, he considered it necessary to have two systems: one to individualise the bodies, and the other to carry out Sir Benjamin Brodie's idea of indicating the formula. It must also be evident that a different sign would be required in the case of certain elements to express their differences in energy; thus at present C represents the carbon either in carbonic acid or carburetted hydrogen, but there was no similarity

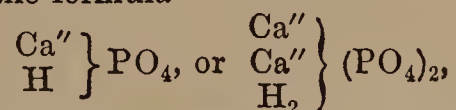


in the two cases, so great was the difference in chemical energy.

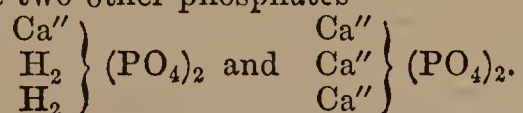
Dr. ODLING considered that the extreme plasticity of Professor Williamson's formulæ was their greatest recommendation, but, on the other hand, he complained that bodies which are not analogous are represented by names which are analogous. Although he would not yet promise to strike out of his vocabulary the little word "of," it was clearly used at the present time by chemists in a signification different from that attaching to it in common parlance. As an example, he might mention the "oxide of chlorine," or the "chloride of oxygen," which are interchangeable expressions in chemistry, but on applying the same test to ordinary forms of language the most ridiculous consequences follow. In his own lectures he commonly adapted two modes of expression; thus he would begin by informing his audience that hydrochloric acid was prepared by the action of sulphuric acid (oil of vitriol) upon "common salt," and then proceed to show upon the black-board the double decomposition which ensued, resulting in the conversion of the "chloride of sodium" into "chloride of hydrogen," &c. Dr. Odling further remarked upon the application of Prof. Williamson's system to the formulating of the calcic phosphates and bismuthic oxychlorides, and maintained that Gerhardt, far from perverting, had the credit of restoring the word "acid" to its original purpose.

Professor WILLIAMSON here admitted a clerical error which had occurred at page 430 of the Society's Journal for December, 1864, in which he had represented incorrectly the formula of the "calcic di-phosphate."

Dr. A. W. HOFMANN said that one of the features which recommended the names adopted by Professor Williamson was that they involved comparatively little theory. In the case of the ordinary phosphates of *divalent* metals, like calcium, for instance, it was a matter of doubt whether the salt standing midway between those which contain the smallest and the largest amount of metal should be expressed by the formula—



the former being the simplest atomic expression by which the salt could be represented, the latter formula indicating more conspicuously the intermediate position of this salt between the two other phosphates—



He certainly preferred names which, like those of Professor Williamson, took no notice of theoretical questions of this kind. The speaker had also repeatedly tried his hand at framing names; and no one would accuse him of having neglected the pictorial representation of the composition of bodies in the names which he had given. He must, however, admit that the time had arrived when individual compounds began to lose a great deal of their former interest. The very accumulation of individual compounds compelled them to look to classes; and what appeared pre-eminently necessary were the appropriate names for classes. In many cases such names as "primary," "secondary," and "tertiary monamines" which he had recently proposed for the ammonias of different degrees of substitution, were really, in most cases, quite sufficient, and might frequently, and with advantage, be substituted for the longer names exhibiting the materials of which the building was constructed. This kind of nomenclature was also applicable to the salts of acids; and such terms as the primary and secondary salts of sulphuric acid, the primary, secondary, and tertiary salts of phosphoric acid, conveyed to the student, he could affirm from experience, a clear and precise idea of the nature of the compounds which they were intended to represent.

Mr. NEWLANDS pointed out an error which had lately

resulted from the improper use of the termination "ine." He found kakodyl described under the name of "dimethylarsine," which term implied that this body was formed on the ammonia type by the substitution of two atoms of methyl for two of hydrogen, and metallic arsenic in place of nitrogen. The body did not, however, contain any hydrogen apart from that which entered into the constitution of the radical, methyl.

At this stage of the discussion, the SECRETARY read a short communication from Mr. G. C. Foster, B.A., entitled, "On Chemical Nomenclature, and particularly on the Use of the Words Acid and Anhydride." The author commences with some excellent remarks upon the requirements of a scientific nomenclature, and insists upon the necessity of having a convenient general language to serve as a medium for all the ordinary purposes of the science; and in the second place, there must be a strictly defined "legal language of the science" which must keep pace with the progress of scientific opinion, and consequently be subject to alteration and reform. The author proceeds then to trace the history of the words "acid" and "anhydride." With regard to the first, it appears that "until the latter part of the last century the substances known as acids were regarded as members of the general class of *salts*, which was commonly divided into *salia acida*, *salia alcalina*, and *salia media vel composita*." Lavoisier then discovered the presence of oxygen in several of the best known acids, and concluded that they were a particular class of oxides. Later research pointed out the differences between these ordinary hydrated acids and bodies, which were obtained from them by the abstraction of water; and ultimately Laurent and Gerhardt limited the application of the term *acid* to salts of hydrogen, such as  $\text{H}_2\text{SO}_4$ , and called the bodies actually or conceivably produced from them by loss of water, such as  $\text{SO}_3$ , *anhydrides*. The author defends the justice of this course as the only alternative open to MM. Laurent and Gerhardt at that time, for whenever acids were spoken of it happened, in the great majority of cases, that the hydrogen salts, and not the anhydrous acids, were referred to; and the adoption of any other name for this class of compounds would have been attended with great inconvenience. After the lapse of twenty years the reasons which necessitated the use of the terms "acid" and "anhydride" no longer hold good, and the author considered that they might now be amended with advantage; for in his opinion the employment of the word "*acid*" could be altogether dispensed with, and the bodies usually indicated by this term be called "hydrogen salts," particularising the individual compounds as hydric sulphate, hydric chloride, &c.; and likewise the continued use of the term "anhydride" is objectionable, since it merely asserted the fact that a given substance is *not* one of a great variety of things which it might have been, whilst the name does not point definitely to what it really is. This latter class the author prefers to describe simply as *oxides*; thus, we should speak of sulphurous oxide, sulphuric oxide, phosphoric oxide, acetic oxide, &c. To such a course there can be only a minor objection, as pointed out by Mr. Watts, to the effect that the terms *carbonic oxide* and *nitric oxide* are already engaged for other compounds; but the same gentleman has suggested the remedy, which consists in resorting to a more specific designation for the oxides in question: thus, CO might still be called "carbonic oxide," and  $\text{CO}_2$  "carbonic dioxide," and so, in like manner,  $\text{N}_2\text{O}_5$  and  $\text{P}_2\text{O}_5$  would be termed respectively "nitric pentoxide" and "phosphoric pentoxide." The author concludes by expressing his opinion in favour of the entire withdrawal of the terms acid and anhydride, and is convinced that the language of chemical science would be benefited by the substitution of "hydrogen salts" for acids, and "oxides" for anhydrides.

Dr. W. A. MILLER coincided in Professor Williamson's opinion that the adoption of the modes of expression



indicated by the ferric and ferrous salts, &c., would be attended with advantage; and he considered the use of the new word "anhydride" very objectionable, inasmuch as it constituted a kind of negative statement, and was not descriptive of the properties of the compound or group thus designated. He would suggest the adoption of the word "oxyl" in its place, and speak of carbonic oxyl, nitric oxyl, &c. It was desirable, perhaps, once more to examine into the applicability of the old terms invented by the late Professor Daniell for the purpose of expressing the electro-negative radical or group which became separated at the positive pole during the electrolysis of a soluble salt. It would be remembered that the names phosphion, sulphion, and nitron were respectively applied to the hypothetical bodies known by the formulæ— $\text{PO}_4$ ,  $\text{SO}_4$ ,  $\text{NO}_3$ ; and by an extension of the same principle, Dr. Miller advocated the employment of "sulphosion" for  $\text{SO}_3$ , "nitrosion" for  $\text{NO}_2$ , "oxalion," &c.

Dr. A. W. HOFMANN said, in connexion with what had fallen from Dr. Miller, that he also had often felt the want of proper terms for this chlorous group,  $\text{SO}_4$ ,  $\text{PO}_4$ ,  $\text{NO}_3$ ,  $\text{CO}_3$ , &c.; in addition there was no generally recognised name embracing these atomic groups as a class. He had lately found a happy designation for these groups in a posthumous work of Charles Mansfield, whose early death had been a great loss to chemical science in this country. In the work to which he alluded, and which would shortly be published by Mr. Maskelyne, Charles Mansfield had intended the use in chemistry of terms originally borrowed from architecture, and exactly as the architect speaks of the *base* and the *style* of a column, Mansfield speaks of the *base* and the *style* of a salt, designating by the term *style* the chlorous groups of saline bodies as a class.

Professor LIVEING suggested for anhydrides a designation analogous to that which has been so long employed in an excellent and well-established example of the class—viz., "silica;" we should then have "nitrosica" and "sulphurica" among a series of names having a like termination.

Professor WILLIAMSON replied briefly to some of the objections raised in discussion, and agreed in the necessity for finding a name which should represent the chlorous radical in salts; in the course of a conversation with Dr. Miller upon the subject, it seemed advisable to call  $\text{K}_2(\text{SO}_4)$  "potassic sulphode," and the salt containing the inferior oxide,  $\text{K}_2(\text{SO}_3)$ , "potassic sulphiode." With regard to the appellation of the so-called hydrated acids, all difficulties would cease in the event of their being described as hydrogen salts.

After a vote of thanks being warmly accorded to Professor Williamson,

The CHAIRMAN stated that, upon the invitation of Dr. Hofmann, it had been decided to hold the next meeting of the Society in the lecture theatre of the Royal College of Chemistry, and upon that occasion Dr. Hofmann had kindly offered to address them upon the subject of "*Lecture Illustrations*." There were other papers in hand which would be read at the first opportunity, and the meeting was then adjourned until Thursday, February 2, at the usual hour.

#### ACADEMY OF SCIENCES.

January 16, 1865.

M. FAYE read the first part of a most interesting memoir "*On the Physical Constitution of the Sun*." In this part he reviews the opinions of Dr. Wilson and the two Herschels; in the second part he states that he shall notice the principal results of modern observations, and endeavour to co-ordinate them, starting with the idea of a progressive cooling of an enormous mass in rotation, the excessive temperature of which keeps all the elements in the chaos of complete dissociation, save and except at the limit which separates the mass from the void and cold of the celestial spaces. We shall look for this part with great

interest, and give our readers a full account of the author's theory.

In the form of a reply to the question *Do the leaves of plants exhale carbonic oxide?* M. Corenwinder describes a simple form of apparatus by which he has been able to prove—

1. That there is no carbonic oxide or other combustible gas in the atmosphere.
2. That dung or manures putrifying in the air give off none.
3. That none is given off by flowers, odoriferous or not.
4. That the leaves of plants never, by day or night, in sunlight or in shade, evolve any. And,
5. That when a plant is exposed to the sun in the presence of carbonic acid, this acid is rapidly absorbed, but no trace of carbonic oxide is expired.

The apparatus is simple enough. The author first draws the air, by means of an aspirator, through caustic potash, to remove all carbonic acid, and then through a tube heated to dull redness, and containing pumice stone and oxide of copper; lastly, the air is made to pass through caustic baryta, to arrest the carbonic acid which may be furnished by carbonic oxide or any other combustible gas.

In a paper "*On the Affinity of Caseine for Acids, and the Compounds which Result*," MM. Millon and Commaille affirm that when caseine is precipitated from milk by an acid, it forms with that acid a definite compound—e.g., hydrochlorate of caseine  $\text{C}_{108}\text{H}_{97}\text{N}_{14}\text{O}_{29}\text{HCl}$ . And so on.

There are one or two other interesting points in the paper which we reserve, merely noticing now the asserted existence of two kinds of caseine in milk—one in suspension with the cream, the other in solution. We may add, too, the authors' belief that caseine is an amide of tyrosine and leucine, the reasons for which belief will appear in the paper.

M. Moncel made a communication "*On the Electro-Magnetic Effects Produced by Uncovered Wire Considered in Relation to the Battery*." On experimenting with a machine on the principle of M. Carlier, noticed last week, the author finds that quantity currents produced the greatest effects when uncovered wires are employed, and that the effects are much stronger when the bobbins are not too well insulated; and further, that the battery surface must be in proportion to the number of spirals, in order to produce the most marked effects.

In a paper "*On the Spontaneous Alteration of Gun-cotton*," M. C. Blondeau states that, in the first place, the cotton parts with some of the nitric acid, and is changed into nitrated cotton, still filamentous, but not explosive, showing no trace of an organic acid. The next stage is a change into a gummy mass, which is composed of xyloidine and oxalhydric acid. This transformation is accompanied by the evolution of binoxide of nitrogen. After this the gun-cotton undergoes several modifications, culminating in the production of glucose and oxalic acid. The foregoing changes took place slowly in the dark, but in diffused light they took place more quickly. In direct sunlight the modifications are somewhat different. The mass soon becomes a deep yellow colour, and is then soluble in water. The aqueous solution heated with potash evolves ammonia, which, the author believes, exists in combination with a portion of undecomposed cotton. Of this peculiar compound he intends to give a further account.

Some "*New Facts in the History of Olive Oil*," by M. Lattier, can hardly be considered novelties. He describes the action of strong and weak chromic acid on the oil, and gives a test founded upon the action of the latter. A solution containing one-eighth of chromic acid should not be opaque after remaining in contact with olive oil for twenty-four hours. A mixture of two parts of the same solution with one part of nitric acid shaken with olive oil should after some days solidify and turn blue, and if it does not, the oil must be considered as adulterated.



## NOTICES OF BOOKS.

*Report of Experiments on the Growth of Wheat for Twenty Years in Succession on the same Land.* By J. B. LAWES, F.R.S., &c., and J. H. GILBERT, Ph.D., F.R.S., &c. London. 1864. Reprinted from the Journal of the Royal Agricultural Society of England.

THE green-books of Messrs. Lawes and Gilbert present many of the characteristics of some Government blue-books—that is to say, they contain a mass of valuable facts, which, however, are so presented that it requires some hard digging to get at them. The books may, indeed, be likened to the authors' crops, which consist of grain and straw, both having a value (though widely different), and the grain not to be had without the straw. But, after all, the grain must be thrashed for, and readers may get the important facts from this book by a process of intellectual thrashing and winnowing.

We regard this as unfortunate, considering the class for which the authors write, a class not given to tough reading, and not easily taught. The bucolic mind requires a special method of teaching. No method is, in general, so successful as bold assertion. Farmers will cheerfully buy a mixture of sand and sawdust, or something equally worthless, which is guaranteed to produce eight or nine quarters, but will seldom listen to suggestions for gradually improving their soil, or hear of the necessity for investigations to determine its requirements. Thus, chemists and chemistry are altogether unappreciated by them as a class. Most of them have at some time or other been the victims of a manure quack, who has talked learnedly of phosphates, nitrogen, and ammonia, but has finished by selling them something which never did the smallest good to their land, and thus they have come to mistrust, not altogether groundlessly, all people who use learned terms and promise large results. It is fortunate for them, then, that there are gentlemen who are not only good chemists, but practical farmers, and can show them results, in place of making them promises.

We regard the series of experiments detailed in this book as perhaps the most important that have ever been made on the growth of wheat. As the authors say, "the records of a field of 14 acres in which wheat has been grown without manure, and by different descriptions of manure, for twenty successive seasons, without either fallow or a fallow crop, and in which the lowest produce was in the first year 15 and in the last 17½ bushels, and the highest in the first year 24½ and in the last 56½ bushels, cannot fail to be of much interest at once to the practical farmer, the economist, and the man of science." The experiments were made on what is called a fair average wheat-land, a somewhat heavy loam, with a subsoil of raw, yellowish-red clay, resting upon chalk, which provides good natural drainage. Now what the practical farmer, before all others, wants to know is, how to make such a fair average wheat-land produce 56½ bushels. He will find out if he reads this book with close attention, but we are obliged to say that he might have been told in fewer words, or, in other terms, might have got his grain with less straw. It is to the "concluding observations" that most readers will turn, and to these we resort for the more prominent results of the experiments. We have already quoted the produce of the unmanured land, and also the highest produce of the manured; let us now see the effects of particular manures.

"With farmyard manure, applied every year, the produce was, in the first year, 20½ bushels; in the last, 44 bushels; and, on the average of twenty years, 32½ bushels.

"With artificial manures the highest produce was, in the first year, 24½ bushels; in the last, 56½ bushels; and, taking the average of the twenty years, 35¾ bushels, or considerably more than the average produce of Great

Britain when wheat is grown in the ordinary course of agriculture in rotation."

The artificial manures here spoken of appear to have consisted of "ammonia salts, *i.e.*, equal parts of sulphate and muriate of ammonia of commerce," and "mixed mineral manure," composed of superphosphate of lime, and sulphates of soda, potash, and magnesia.

With regard to the effect of these manures applied separately we read as follows:—"Mineral manures alone, though applied in the soluble form, increased the produce scarcely at all; that is, they did not enable the plant in any material degree to assimilate more nitrogen and carbon from atmospheric sources than when it is grown on the practically exhausted, unmanured land.

"Nitrogenous manures alone increased the produce very considerably for many years in succession; hence, the soil in its practically exhausted condition was relatively much richer in available mineral constituents than in available nitrogen.

"The largest crops were obtained when mineral and nitrogenous manures were employed together; and it was by such mixtures, even though they supplied no silica (nor carbon), that the produce by farmyard manure was far exceeded, although the latter supplied, not only both silica and carbon, but all other constituents in larger quantity than they were removed by the crops."

A brief record of results obtained upon soils of other description follows, from which we gather that similar treatment in all cases produces like effects. And here, of course, Baron Liebig crops up, who appears in Mr. Lawes' books with the same pertinacity that King Charles did in Mr. Dick's petitions. Now, once and for all, we would recommend Mr. Lawes to let Baron Liebig alone, to steadily pursue the useful course he has marked out for himself, to state plainly and without confusion the practical results of the valuable experiments he undertakes; and some day a philosopher will no doubt give us the true scientific explanation of the facts, while in the meantime flourishing agriculturists and a well-fed people will not be slow to pay the debt of gratitude which will be owing to our author.

We should have liked to say something on the waste of phosphates, on the uses of potash, and on the application of sewage, but space fails us. On the last point, however, we may say that our own ideas are in perfect accordance with those of our author. In conclusion, we must commend this book to the serious study of all our agricultural readers.

*Annales de Chimie et de Physique.* December, 1864.

WE have in this journal the continuation of M. Lamy's memoir "*On Thallic Alcohols*," an abstract of which we have already published. The next is an interesting article by Marshal Vaillant "*On the Hourly Variations of the Barometer*," to account for which he offers an ingenious, and, perhaps, satisfactory theory. The mercurial column ordinarily reaches its maximum of height about 9 to 10 in the morning. From that time it begins to fall, and reaches its minimum about 3 p.m. Remaining still from 3 to 4, it then begins to rise between 4 and 5, and about 9—10 p.m. reaches again its maximum of height. What happens to cause this the Marshal explains by a familiar illustration, which we abstract, only remarking that the sun plays the part of the fire here mentioned. When a fire has been extinguished for some time, the air in a room and in a chimney is almost quiescent. When a fire is lit, the lower portion of air in the chimney becomes heated, and tends to rise; but it has to make its way through the column, which occupies the whole chimney, and consequently set this whole column in movement. The struggle lasts some time; sometimes the hot air, not being able to rise sufficiently fast, returns to the room, and the chimney smokes. As long as the struggle lasts the air in the body of the chimney is compressed. This is the first phase of the



diurnal period; it corresponds to the heating of the surface of the earth by the rising sun. A moment arrives when the pressure of the air in the chimney reaches its maximum, which corresponds to the barometrical maximum observed from 9 to 10. The current being established in the chimney, the tension diminishes, and now the fire being kept up, the tension gets lower and lower. This is what happens from 9 or 10 to 3 p.m. Now the fire being allowed to go out, the reverse happens, and at last the air again comes down the chimney. Our readers will no doubt see the force of the illustration.

The next is a very interesting paper by M. Cahours, "*On Isomeric Bodies.*" It would be impossible for us to give a satisfactory account of the author's ideas in the short space we could devote here, so we shall present them in the form of an abstract of this paper.

We have already, in our reports of the Academy of Sciences, given some account of M. Roux's "*Examination of Sea Water,*" of which, however, we have here some further particulars. Eighty-eight samples of water were collected for him, in various latitudes, during a voyage from Bourbon to Bordeaux. The author took the specific gravities and estimated the chlorine and saline contents of all these; and all we need say is, that he found very small differences between them. It appears that the water of the northern has rather a higher density than that of the southern hemisphere; the author's experiments, however, seem not to accord with the statement that the saltiness of the water increases with the distance from the coasts.

In the very useful review of foreign chemical works, which now forms part of the *Annales*, the writers are, in point of time, far behind the CHEMICAL NEWS, most of the papers noticed being at least six months old.

*Zeitschrift für Analytische Chemie.* Edited by Dr. C. R. FRESSENIUS. Second Part. 1864.

THIS part opens with a short paper by Erdmann "*On the Action of Nitrite of Potash on Nickel Solutions in the Presence of Lime, Baryta, or Strontian.*" A process has been given for the separation of nickel from cobalt based on the reaction of nitrite of potash, which forms a double compound of nitrite of potash and cobalt. Dr. Künzel, however, has found that in the presence of lime, baryta, or strontian, a similar yellow compound of nickel is precipitated, and therefore this method of separating nickel and cobalt is only applicable in solutions free from the alkaline earths.

Dr. E. Dietrich describes an ingenious and, we should say, useful form of "*Apparatus for Gas Analysis.*" The description is accompanied with plates, without which it would be unintelligible.

H. Stöss gives a "*Method of Valuing Commercial Anilin, Benzin, &c.*" It is, of course, a distillation process, and offers nothing remarkable.

A short note, by J. Löwenthal, "*On the Uselessness of Peroxide of Lead in Quantitative Analysis.*" Peroxide of lead has been proposed for estimating nitrous acid, but the author shows that, contrary to the common opinion, peroxide of lead is soluble in dilute acids in the cold.

In a paper "*On the Determination of Lime as Caustic Lime,*" Fritsche recommends that the ignited oxalate should be weighed as caustic lime, and not carbonated; and similarly, a precipitated carbonate, not simply dried, but fully ignited for a quarter of an hour, if the quantity does not exceed one gramme, for half an hour if it does.

Dr. A. Fröhde communicates a process for "*The Analysis of Double Cyanides by Hyposulphite of Baryta.*" The cyanide is well mixed with forty times its weight of the baryta salt, and the mixture fused in a covered porcelain crucible until the metallic and alkaline cyanides are converted into sulphides. The mass is then dissolved in water, and excess of baryta precipitated by a few drops

of sulphate of ammonia. The liquor is now filtered, and the metallic sulphides are extracted from the residue on the filter by hydrochloric and nitric acid, and the metals determined by known methods. The filtrate is evaporated with hydrochloric acid to get rid of hydrosulphocyanic acid, and the alkaline sulphates converted into chlorides by chloride of ammonium. Potash, soda, and magnesia can then be separated and determined by known methods. This process is specially applicable to the platino-cyanides.

The same author gives a short "*Contribution to the History of Hyposulphurous Acid,*" showing that a hyposulphite is formed by the action of the air on a polysulphide. He found that sulphide of ammonium, evaporated almost to dryness, the residue dissolved in water, filtered from the separated sulphur, gave all the reactions of an alkaline hyposulphite.

A paper by Dr. F. Stohmann, "*On the Valuation of the Commercial Manures,*" contains nothing of importance to English chemists, except a suggestion for estimating free ammonia which may be lost in determining the moisture in a guano. For this the author dries the guano in a tube, through which he draws, by means of an aspirator, a current of dry air, which is made to pass through bulbs containing a standard acid, by which the ammonia is arrested, and can be determined in the usual way. Every chemist will see the arrangement necessary for this.

A communication, "*On the Detection of Arsenic in Antimonial and other Chemical Preparations,*" by J. M. Scherer, calls for no notice. Fresenius, in a short paper, gives the *Solubility of Arseniate of Ammonia and Magnesia* in pure water and water containing free ammonia, or chloride of ammonium, or both. The solubility is slight, but must be taken into account when arsenic acid is determined in that form. One part of the anhydrous salt dissolves in 2788 parts of pure water, in 15,786 parts of water containing ammonia (1 liq. ammon. to 3 of water), in 1380 parts of dilute solution of sal ammoniac, in 886 parts of strong solution of sal ammoniac, and in 3014 parts of a mixed solution of ammonia and sal ammoniac.

Fresenius also notices Lensenn's "*Volumetric Method for Estimating Manganese by the Reduction of Ferridcyanide of Potassium.*" This method is given in the last edition of the writer's quantitative analysis, and now having tried it the author states that although the results are not strictly accurate, yet they come sufficiently near for ordinary purposes.

The remainder of the journal consists of extracts from other periodicals, in many of which we have anticipated it, but we shall give some from periodicals which do not reach us.

*The Year-book of Pharmacy: a Practical Summary of Researches in Pharmacy, Materia Medica, and Pharmaceutical Chemistry during the year 1864.* Edited by C. H. Wood, F.C.S., and C. SHARP. London. 1865.

WE have, on many occasions, complained of the absence in this country of some of those useful annual publications which bring together the scientific discoveries of a past year in a form which makes them easily accessible to readers who have but little time or opportunity to search for them in more extended works. The medical profession supports two such periodicals, and it will be strange indeed if the pharmaceutical profession does not appreciate the attempt of the editors of this book to supply a want which every pharmacist must have felt. "*The Year-book of Pharmacy*" will, no doubt, find its place on the desk of every chemist and druggist, who will find it to supply them, in a concise form, with all the most useful facts relating to pharmacy which have been published during the past year. We heartily wish the editors the success they deserve.



# NOTICES OF PATENTS.

1203. *Treating Canvas, Tarpaulings, or other Painted Canvas, to Render them Suitable for Household Purposes.* W. HORNE, West Ham. Dated May 12, 1864.

THIS is an ingenious method of treating waste material in the form of old oil cloth, &c., by extracting on the one hand the resins and pigments, and saving the fabric for renewed employment. The waste pieces of painted canvas or tarpauling are immersed for six hours in an aqueous solution of oxalic acid, containing one pound of the crystals to 100 gallons of water. They are next treated with a strong solution of American potash, about 25 lbs. weight to 100 gallons; then with sesquicarbonate of ammonia solution of the same strength. The articles are then washed with warm water, and subjected to hydraulic or other pressure, which facilitates the removal both of salts and pigments; and, if necessary, the cloths are then further treated with pearlash, or other alkaline solution, and finally washed with cold water.

1218. *Manufacture of Card Cloth and other Waterproof Fabrics.* A. BATEMAN, Low Moor, near Bradford. Dated May 13, 1864.

THE inventor prepares a fabric, which is both oil and water proof, by uniting two thicknesses of calico, linen, woollen cloth, or leather, by means of an elastic compound varnish composed of—

Gutta percha	.	.	.	55 parts.
India rubber	.	.	.	10 "
Gum lac	.	.	.	5 "
Bisulphide of carbon	.	.	.	20 "
Cinnabar	.	.	.	5 "
Plumbago	.	.	.	5 "

1254. *Bottles or Vessels for containing Poisons.* J. B. MERRIKIN, Bath. Dated May 18, 1864.

THE patentee claims the use of bottles or vessels made by casting or moulding, and having protuberances or projecting portions upon their external surfaces, so that the sense of feeling may aid that of vision, and furnish a two-fold indication of the dangerous nature of their contents.

1258. *Manufacture of Zinc.* J. WEBSTER, Birmingham. Dated May 18, 1864.

THIS invention relates a new mode of reducing zinc from its ores, and of determining the volatilisation of the separated metal. The zinc ores are to be roasted, and the oxide of zinc so formed is brought into contact with molten iron in a suitable furnace, whereby the iron takes the oxygen, and the zinc is made to sublime, the metallic fumes being afterwards condensed in the usual manner.

The known affinities of iron and zinc, both in the metallic form and as oxides, would, we should suppose, have entailed a loss of metal.

1259. *Improvements Applicable to Street and other Lamps or Lanterns.* J. BROWNING, Grosvenor Road, Pimlico, London. Dated May 18, 1864.

FOR the purpose of economising the rays of light which radiate upwards from street lamps, the inventor uses reflectors fixed at such an angle as will have the effect of throwing those rays outwards or downwards.

It is surely time that some available plan of reflecting the top light were discovered and applied. Many experiments have been tried in the street lamps of this metropolis, but years have rolled on without any general scheme being practically adopted.

1262. *Metallic Alloys.* T. DUNLEVIE, Dublin, and J. JONES, Liverpool. Dated May 18, 1864.

THE patentees claim the manufacture and use of alloys

containing spelter (zinc), tin, and small quantities of copper and antimony.

The alloys of tin and zinc alone have often been made and described; they are perfectly uniform throughout, of brilliant white colour, hard and durable, and not prone to oxidation; but their cost is even greater than brass, which for most purposes would be preferred on account of its colour.

## GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

3045. E. T. Hughes, Chancery Lane, London. "Improvements in treating aniline colours for dyeing and printing." A communication from A. S. L. Leonhardt, Berlin. Petition recorded Dec. 6, 1864.

3093. C. Hancock, West Street, Smithfield, and S. W. Silver, Bishopsgate Street, London. "Improvements in colour printing."

3102. A. P. Price, Lincoln's Inn Fields, Middlesex. "Improvements in obtaining carbonic acid gas."—Dec. 14, 1864.

3161. S. P. A. de Brocalde d'Elüza, Leicester Square, Middlesex. "A new or improved manufacture of artificial manure."—Dec. 20, 1864.

3184. R. L. Howard, Upper Whitecross Street, Middlesex, and J. Daughlish, M.D., Reading, Berkshire. "Improvements in apparatus for making aerated bread."—Dec. 22, 1864.

3192. J. Bethell, King William Street, London. "Improvements in preserving wood."—Dec. 23, 1864.

3229. J. D. Morrison, Wemyss Place, Edinburgh, N.B. "Improvements in painless dentistry, by apparatus for cooling and tempering air and applying it as an anæsthetic agent."—Dec. 29, 1864.

12. W. G. Helsby, Liverpool, Lancashire. "Improvements in the manufacture of enamelled glass, to render it more useful in photographic art."

16. T. J. Ashton, Cavendish Square, Middlesex. "An improved portable pneumatic apparatus, applicable in surgery and medicine for all purposes, as a douche for affusion, irrigation, injection, and for enemas."—Jan. 3, 1865.

39. T. Pickford, Fenchurch Street, London. "Improvements in preparing and keeping aerated beverages."—Jan. 5, 1865.

47. W. C. Thurgar, Norwich. "A new or improved method of keeping the substance of eggs fresh and sweet."

51. J. Robertson, Glasgow, N.B. "Improvements in furnaces, ashpits, and flues for the consumption of smoke and noxious products of combustion, and in the apparatus or means connected therewith."—Jan. 6, 1865.

79. T. B. Belgrave, M.D., Bracebridge, Lincolnshire. "Improvements in preserving meat."

81. D. Gattafeut, Stepney Causeway, Middlesex, and F. Pontifex, Shoe Lane, London. "Improvements in artificial fuel."—Jan. 10, 1865.

93. A. G. Lock, Millbrook, Hampshire. "Improvements in extracting and purifying fats and other products from bones and other animal substances, and in apparatus for the same."—Jan. 11, 1865.

## NOTICES TO PROCEED.

2244. J. H. Johnson, Lincoln's Inn Fields, Middlesex. "Improvements in the preparation or treatment of colouring matters obtained from aniline." A communication from H. F. G. de Claubry, Paris, France.—Petition recorded Sept. 14, 1864.

2294. R. A. Brooman, Fleet Street, London. "Improvements in the manufacture of phosphuret of iron, phosphate of lime, and alkaline phosphates." A communication from Edouard Aubertin, Paris, France.—Sept. 19, 1864.

2470. W. Clark, Chancery Lane, Middlesex. "Improvements in preparing or treating vegetable fibrous



materials." A communication from Hubert Dupré, Boulevard St. Martin, Paris.—Oct. 7, 1864.

2564. J. Maurice, Langham Place, Middlesex. "Improvements in the means or method of producing optical illusions in theatres or exhibitions."—Oct. 17, 1864.

3062. R. A. Brooman, Fleet Street, London. "Improvements in apparatus for cooling and freezing." A communication from Marcar Beylih'g, Constantinople, Turkey.—Dec. 8, 1864.

3185. J. Gillespie, Garnkirk, Lanarkshire. "An improved construction and manufacture of retorts, crucibles, glasshouse pots, and other similar vessels, and in the means and apparatus employed therein."—Dec. 22, 1864.

3195. R. A. Brooman, Fleet Street, London. "Improvements in coke ovens." A communication from F. J. F. Laumonier, Angers, France.—Dec. 23, 1864.

## CORRESPONDENCE.

### *The Society of Arts and Dr. Hofmann's Report.*

To the Editor of the CHEMICAL NEWS.

SIR,—I have read Mr. Le Neve Foster's defence of the Society of Arts, and am by no means satisfied with it. I will illustrate the consequences of the conduct of the Society by my own case. I am not a member of the Society, but I wished to have the Reports of the Exhibition, and, moreover, I was anxious to read them as soon as I could. I therefore purchased them as they appeared of Bell and Daldy, in Fleet Street, the Society's publishers. Naturally enough, I was most anxious to procure the report most interesting to me, that on Section II., Class A., and was, I need not say, disgusted enough on learning that none would be sold separately. It therefore appears that after purchasing of the Society the greater part of the Reports, I cannot buy what I want to complete my set, but must buy the whole series over again in the shape of a fifteen shilling volume. If a similar course had been pursued by any private publisher, the proceeding would be stigmatised as a "do," and I do not see why the same term should not be applied to this transaction of the Society of Arts. I am by no means sorry to learn that the publication of the Reports has ended in a pecuniary loss to the Society, and I shall never think of subscribing to any further publication of the Report by the Society; but I shall willingly put my name down for a republication, with additions, by Dr. Hofmann, which, I believe, would be successful.—I am, &c.

A CHEMIST.

London, January 22.

### *Japanese Matches.*

To the Editor of the CHEMICAL NEWS.

SIR,—On reading Dr. Hofmann's pretty little communication to the Chemical Society (CHEMICAL NEWS, December 24, 1864) upon the "Japanese Matches," I remembered that the prescription for them is given in Pepper's "Play-book of Metals," though without, as far as I can recollect, any reference to the Japanese.

Mr. Pepper gives the following:—

Nitre	.	.	.	4 parts
Sulphur	.	.	.	2 "
Lamp-black	.	.	.	1.5 "

as a composition emitting beautiful rosettes during combustion.

Dr. Hofmann prescribes:—

Nitre	.	.	.	4 parts
Sulphur	.	.	.	1.85 "
Wood-charcoal	.	.	.	1.23 "

and the composition is stated to burn with sparks branching out in beautiful dendritic ramifications.

I am sorry that I have not Mr. Pepper's book at hand just now, and cannot refer to the exact page from which I copied the above prescription at least two years ago.

I have always felt a regret that the highly popular style of Mr. Pepper's writings should have caused many interesting experiments to remain unknown to some of our most eminent lecturers, who have consequently been put to the trouble of re-inventing them.

The particular work from which I have quoted contains, as you would expect, a great heap of "chaff" for the juveniles, but older birds may pick out enough corn to repay them for turning it over. I am, &c.

"AT HOME FOR THE HOLIDAYS."

### *Coal as Food for Pigs!*

To the Editor of the CHEMICAL NEWS.

SIR,—My wife has fed her pigs with small coal for a long time. She administers it at the rate of one shovelful per day per animal, with the same regularity that the children get their "black draught." Not only do coals go down with a gusto, but cinders from under the grate are equally relishable. I shall leave the chemistry of the affair to you; but there is no doubt about the efficiency of the specific, especially where piggy is confined, and not allowed the run of the parish, I am, &c.,

G. P.

Ebbw Vale, January 23, 1865.

[We print this note, having no reason to doubt the writer's good faith.]

## MISCELLANEOUS.

**Chemical Society.**—The next meeting of this Society will be held in the Theatre of the Royal College of Chemistry, Oxford Street, W., on Thursday evening next, when Dr. Hofmann will give a discourse "On Lecture Illustrations."

**Renard v. Levinstein.**—Vice-Chancellor Sir W. P. Wood delivered his judgment in this case on Tuesday last. His Honour found for the plaintiffs on all the issues, thereby declaring Girard's patent valid, and deciding that the defendant's process was an infringement of the patent. We shall give an abstract of the judgment (which occupied two hours in delivery) in our next number.

**Eidos Aeides.**—Among the many recent applications of optical science to scenic illustrations, no one has been more strikingly effective than that now to be seen at Her Majesty's Theatre under the above title. The instantaneous substitution of one living figure, in all its solid reality, for another equally solid and real—the visible becoming invisible, and the invisible visible—is one of those startling effects which a few generations ago would have caused the inventor to be regarded as having dealings with the black art. So skilfully is the illusion arranged, that an ordinary observer would quite fail to obtain the smallest clue to the method by which it is effected. To one well versed in the modern way of raising ghosts, a few circumstances he might notice would suggest that a sheet of glass and an electric or lime light had something to do with it; but, so perfect is the illusion, and so effective the dramatic situation, that it would be wrong to spoil the delight of witnessing the scene by intruding the means by which the effect is produced. Theatrical criticism is not our vocation, but we may say that our readers will be greatly amused and astonished by the Eidos Aeides, and its accompaniments.

## ANSWERS TO CORRESPONDENTS.

*Received.*—W. Arnott; will appear in our next.

*Enquirer.*—The so-called "varnish" is composed of beer-finnings coloured black.

*Juvenis.*—Use a little less sulphur, and gunpowder.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.

## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION I.—Historical Development of the Ideas, Equivalent, Atom, Molecule.

(Continued from page 38.)

Nearly twenty years passed over before this question of the proportion between the weights of acids (or bases) saturating a definite amount of a base (or an acid) was again taken up. Another German chemist, Richter, of Berlin, drew attention to the subject in a work which he published in 1792 or 1794, entitled *Stœchiometry, or the Art of Measuring the Chemical Elements*.\* Besides this he published between 1792 and 1802 a periodical work, called *Ueber die Neueren Gegenstände in der Chemie* (Later Discoveries in Chemistry), the seventh, eighth, and ninth numbers of which are especially interesting. The author observed and explained, as did Wenzel, the phenomenon of the permanence of neutrality after the mutual decomposition of neutral salts. He determined the relative saturating capacity of acids and bases. He noticed that when a metal precipitated another metal from a solution of a neutral salt the liquid remained neutral. From this last observation he deduced a very correct explanation by showing that there existed a constant ratio between the amount of an acid saturating given weights of different bases and the quantity of oxygen contained in these bases; or, what comes to the same thing, that the quantity of oxides required to saturate the same weight of a given acid contained the same amount of oxygen.

To Richter we owe the first tables of equivalents. They are drawn up in reference to the reciprocal saturation of acids and bases, and consist of two kinds of tables.

The first shows the weight of different bases which neutralise 1000 parts of an acid—sulphuric acid, for instance.

The second shows the quantity of acids required to neutralise 1000 parts of a base, such as potash or lime.

The figures which compose these tables are derived from analyses which are less exact than those of Wenzel, and which appear to have been corrected, too late, to make them agree with certain theoretical ideas which were more erroneous than the experiments themselves.†

For all that, Richter recognised this important fact, that the weights of bases forming the first series were proportional to each other, and that the same proportionately existed between the quantities of acids forming the second series; so that if he knew the quantities of all the bases which neutralised an acid A, it would be sufficient, in order to find the amount of any base which would be required to neutralise another acid A', to determine by one experiment the weight of any one of the bases necessary to form a neutral salt with this acid A'; knowing the weight of this base, it would be easy to calculate the weight of all the others. Thus Richter

showed that the composition of a great number of salts could be reduced theoretically from the known composition of certain other salts—an important deduction from the fact of the proportional relation between acids and bases which had been already established by Wenzel, and which the Berlin chemist saw the force of in all its bearings.

One thing, however, escaped him, and that was that it was useless to multiply the series so much, and that they might all have been founded on one alone. Indeed, after having determined the quantity of different bases required to neutralise 1000 parts of sulphuric acid, it would have been enough instead of determining the quantity of base which would neutralise another acid, to find out how much of the other acids would be required to saturate the weight of any one of the bases neutralising 1000 parts of sulphuric acid. These amounts of acids would be equivalent to 1000 parts of sulphuric acid, and would exactly saturate the weight of base neutralised by 1000 parts of this acid. It is seen from this that Richter need have constructed only one table of equivalents of bases and acids calculated in relation to 1000 parts of sulphuric acid. Fischer calculated a table of this kind from Richter's data, and published it in 1802.‡ The following is a copy of it:—

Bases.	Fischer's numbers.	Theoretical numbers.
Alumina . . . .	523	428
Magnesia . . . .	615	500
Ammonia . . . .	672	
Lime . . . .	793	700
Soda . . . .	859	775
Strontia . . . .	1329	1295
Potash . . . .	1605	1177
Baryta . . . .	2222	1912
Acids.	Fischer's numbers.	Theoretical numbers.
Sulphuric . . . .	1000	1000
Hydrofluoric . . . .	427	500
Carbonic . . . .	577	550
Hydrochloric . . . .	712	912
Oxalic . . . .	755	900
Phosphoric . . . .	979	887½
Formic . . . .	988	925
Succinic . . . .	1209	1224
Nitric . . . .	1405	1350
Acetic . . . .	1480	1275
Citric . . . .	1683	1375
Tartaric . . . .	1694	1650

It will be noticed that for many bodies Fischer's numbers are widely different from the theoretical figures, and consequently the analyses of Richter from which they are calculated were not nearly so accurate as those of Wenzel. The inaccuracy of these analyses, and the obscurity of a perplexed explanation, have not been much noticed in giving Richter credit and some authority to his works.

One thing, however, remains established: Wenzel and then Richter have introduced into the science the notion of equivalents.

(To be continued.)

On the Estimation of Phosphates, and the Detection of Fluorine in Coprolites, by W. ARNOT, Andersonian Laboratory, Glasgow.

ABOUT four years ago a paper appeared in one of the

\* *Stœchiometrie oder Messkunst Chemischer Elemente*, by Jeremie Benjamin Richter, in three volumes. The word stœchiometry is used in Germany at the present day to designate that branch of the science which treats of the equivalents. Richter died at Berlin in 1807.

† Richter imagined that the weights of acid neutralising the same base were in geometrical progression, and that the quantities of base neutralising the same acid were in arithmetical progression.

‡ Hermann Kopp, *Geschichte der Chemie*, vol. ii, page 364.

§ This number is half of 1775, which represents the weight of PO<sub>5</sub>, if 1000 represents that of SO<sub>3</sub>. But it must be noticed that to neutralise PO<sub>5</sub>, that is to say, to form 2NaO.HO.PO<sub>5</sub>, there must be twice as much soda as is required to neutralise SO<sub>3</sub>. The quantity of phosphoric acid strictly equivalent to SO<sub>3</sub> is therefore half PO<sub>5</sub> under the circumstances in which Richter was placed.



chemical journals, setting forth that tribasic phosphate of lime was soluble in chloride of ammonium. Since then many chemists have, I believe, given the question consideration, and have, no doubt, kept the fact in view in the course of their analyses. The investigations, the results of which are herein detailed, originated in the marked discrepancies in the analysis of a sample of coprolite, as reported by several chemists of eminence, to whom it had been submitted. The amount of phosphates, upon which the value of the article mainly depends, was reported by one at 58 per cent., by another 59, by a third 61, a fourth 62, and by a fifth 64. What could any one, either scientific or commercial, make of such results? Error there must be in at least four, if not in all, of these figures. The discovery of the cause of this error was a task assigned me, and as the results of my investigations appear to be possessed of some practical value, as well as scientific interest, I do not hesitate to lay them before the readers of the *CHEMICAL NEWS*.

Four of the above estimates were, I have ascertained, obtained by the same process—viz., by direct precipitation with ammonia, and re-solution. Now, although the process is seldom or never recommended in standard works on chemical analyses, and manifestly on account of the solubility of the precipitate in the menstruum, it is nevertheless very frequently practised in the analyses of commercial products.

To what extent  $3\text{CaO}, \text{PO}_5$  is soluble in chloride of ammonium seems to be but little understood. The following results of two sets of experiments will help to show that it is so to a very appreciable extent. In each of five experiments with a sample of coprolites, specially pulverised and mixed for the purpose, conducted simultaneously, and with the same weight of the sample in each, exactly the same treatment was followed till the second precipitate was obtained, the first being re-dissolved as usual. The five precipitates, as nearly alike as careful manipulation could make them, were redissolved respectively with  $\frac{1}{8}$ ,  $\frac{1}{4}$ ,  $\frac{1}{2}$ , 1, and 2 oz. of HCl, 6 oz. of water being employed in each case. Having re-precipitated, the following were the results obtained:—

With $\frac{1}{8}$ oz. HCl, precipitate gave 57.08 per cent.			
„ $\frac{1}{4}$	„	„	55.83 „
„ $\frac{1}{2}$	„	„	53.33 „
„ 1	„	„	49.50 „
„ 2	„	„	46.66 „

The effect of continued reprecipitation is shown by the following:—15.24 grs. of sample gave first precipitate 65.24 per cent.; the second, 59.90; the third, 56.73; the fourth, 53.85; the fifth, 51.56; and the sixth, 49.83. From these experiments it is very evident that the process of precipitation with ammonia is a faulty one, and sufficiently so, in my estimation, to account for the discrepancies in the results referred to, arising, no doubt, from variable quantities of HCl having been used, and, consequently, of chloride of ammonium.

By some analysts, who rely on extensive washing for the removal of the excess of lime, which is invariably carried down in the first precipitation, the first precipitate is the one reported. By others the second precipitate is the one usually given, while a few go as far as the third precipitate. There are, however, other causes which militate against the process—so far, at least, as its application to coprolites is concerned. The effect of bulk of solution is one of these, and is here shown. The quantity of acid employed in each case was the same, and they were all brought uniformly to the second precipitation.

With 2 oz. solution, precipitate gave 56.83 per cent.			
„ 4	„	„	56.83 „
„ 6	„	„	56.10 „
„ 8	„	„	55.35 „
„ 16	„	„	53.25 „
„ 24	„	„	50.40 „

Increase of bulk is here followed by decrease of precipitate.

The fluoride of calcium in coprolites also affects the accurate determination of the phosphates, when the ordinary precipitation method is employed. It is completely dissolved by the dilute HCl, and is thrown down on the addition of ammonia. In a particular experiment, the phosphates were precipitated from 50 grs., redissolved, precipitated, dried, ignited, and tested for fluorine; unequivocal evidence of its presence was obtained. The insoluble from 100 grs. was next treated for fluorine, but not the slightest trace was detected. Altogether, then, the process seems to be a fallacious one, being neither scientifically correct, nor suitable for commercial valuations.

Several sets of experiments were likewise conducted for the purpose of satisfying myself as to the reliability of the ammonio-phosphate of magnesia method, and with entirely satisfactory results. I simply give the results of one set, premising that in each experiment different bulks of solution and proportions of chloride of ammonium were employed. The following were the percentage quantities obtained:—60.35, 60.25, 60.45, 60.30, 60.35, 60.20. These differences cannot be attributed to faults in process, but are admittedly due to defects in manipulation. No fluorine was discovered in the phosphate of magnesia precipitate.

To the various other methods for the estimation of phosphoric acid, it is not necessary to refer; several of them are quite trustworthy, but they do not admit of application in ordinary commercial analyses. I may, however, offer a remark with reference to the detection of fluorine in this manure. In a popular technical work recently published, it is stated that the presence of fluorine in coprolites may be easily detected in the usual way, as hydrofluoric acid, by the etching power of the gas. Now, the result of experience in this laboratory goes to show that such is not the case. On adding  $\text{SO}_3$  to the powdered coprolites HF certainly is formed if fluorine be present, but owing to the presence of silica in the coprolites, it is immediately converted into fluoride of silicon, and is thus disguised from the test referred to. In the state of fluoride of silicon, it may be readily detected by passing the gas through water, or into a tube, the interior of which has been moistened with water.

I may mention in conclusion that the analysis of a phosphate of lime precipitate, after five precipitations, gave proportions of CaO and  $\text{PO}_5$  corresponding very closely with  $3\text{CaO}, \text{PO}_5$ , which tends strongly to show that the loss by reprecipitation is owing to the solubility of  $3\text{CaO}, \text{PO}_5$  in chloride of ammonium, and not, as is sometimes supposed, to the abstraction of lime alone.

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*On the Solubility of Sulphate of Lead in Pure Water at 15° C., by GEORGE F. RODWELL, F.C.S.*

Two thin glass flasks, of as nearly the same weight and capacity (620 c.c.) as possible, were thoroughly cleaned with acid, dried, heated in an air-bath to 190° C., and after standing several hours in vacuo over commercial sulphuric acid, were weighed. The first was weighed by substitution, and the weight of the second determined



by counterpoising it by the weighed flask, and making up the very slight difference by weights. Into one flask was weighed a quantity (about 500 c.c.) of solution of sulphate of lead in water, and into the other the same quantity of distilled water, similar to that used for the solution of the sulphate, the requisite corrections being made for displaced air, &c. The sulphate had been digested in water at the ordinary temperature for about two months, in a stoppered bottle, and at the same time a similar bottle was filled with distilled water, the amount of each taken for a determination was filtered before weighing, and evaporated to dryness in the flasks, which were then heated, cooled in vacuo, and weighed with the same precautions as before; the traces of residue left by the distilled water being subtracted from that left by the sulphate solution of course gave the absolute quantity of sulphate of lead dissolved by a known amount of water.

Stas has shown that the most carefully distilled water leaves an appreciable residue, and moreover, it is to be imagined that a trace of solid matter would be dissolved from a glass vessel by water which remains for two months within it; I invariably found that 500 c.c. of water left a residue capable of being accurately weighed, and sufficient in quantity to have vitiated the results if left undetermined.

Every precaution was taken to treat the two flasks and their contents in precisely the same manner, the area of the mouth of each was equal, the evaporations were carried on in close proximity to each other, and with as nearly the same amount of heat as possible, and the time of the flasks remaining in vacuo, and that occupied by weighing them, was the same in each determination.

100 parts of water at 15° dissolve of sulphate of lead:

·00323

·00321

·00322

·00296

Mean = ·003155

Hence 1 part of sulphate of lead is soluble in—

31061·8066 parts of pure water at 15°.

When a solution of sulphate of lead in water is evaporated to small bulk, the sulphate is deposited in crystals, which are seen under the microscope by the use of a very high power to be of the following forms:—



When a solution of sulphate of lead in water is treated with sulphuretted hydrogen, it becomes distinctly brown, so much so that an object is perfectly invisible when seen through a column five inches deep, and only becomes visible as a bare outline when the column is reduced to a depth of four and a quarter inches.

## TECHNICAL CHEMISTRY.

*Contribution on the Manufacture and Refining of Cane Sugar, by CH. A. GOESSMANN, Ph.D., Syracuse, New York.*

(Continued from page 28.)

To ascertain the effect of ferment\* upon cane sugar after boiling, I proceeded as follows:—I added a large

\* On account of the similarity of effects of the ferments from the juice of sugar cane and those from malt, I was induced to select common fresh brewer's yeast for my experiments. This ferment was once washed before being used; it proved in that state very active.

quantity of ferment to a solution of cane sugar of 16°—17° Baumé, at 18°—19° Celsius. Then I raised very rapidly the temperature of the mixture to its boiling point (102° Cels.), and kept it boiling nearly one hour, after which time I carefully separated, by filtration, the solution from the insoluble parts. Trommer's grape sugar test proved that the solution contained a considerable quantity of the latter. Subsequently I divided the solution into equal parts, and put each part into a glass flask of sufficient size. One part, which I will call No. 1, was left unaltered; to the other I added several ounces of carbonate of lime (pulv. chalk). I closed both flasks with corks, containing properly shaped glass tubes, for passing the gas probably evolved in a solution of caustic lime. Both corks were sealed to render them perfectly tight, and I kept the farther ends of the tubes almost constantly under lime water. Both experiments were carried on at 20°—22° Cels. during the same duration of time. Their final results were ascertained on the same day. The solution in No. 1 began within a few days to ferment briskly; a small quantity of mould was formed upon the surface of the liquid. The evolution of carbonic acid gas became more and more lively; during the succeeding days the mould disappeared gradually from the surface. After being kept three or four weeks, no further apparent change could be observed; the bottom of the flask was found to be covered with a thin layer of dirty white sediment. This sediment contained a considerable quantity of tricalcic phosphate. Heated by itself, it smelled like burned glue; and mixed with an excess of hydrated caustic lime, it evolved abundantly ammonia gas. I separated the sediment from the liquid by filtration, and subjected the latter to a process of distillation, increasing finally the temperature for some time to 125°—130° Cels. Thus I obtained 105 grms. of an alcoholic distillate, equal to 15° Richter, at 18° Cels., containing a quantity of free acetic acid equal to 0·3965 grms. of acetate of soda. The remaining non-volatile, syrup-like mass was brown, having an acid reaction, tasted sweet, and was easily again brought, by increased ferment, to a rapid fermentation. It contained no cane sugar, no mannite, no lactic acid, and consisted, in its entire mass, of a concentrated solution of grape sugar, with traces of acetic acid. Whether any succinic acid had been produced, as C. Schmidt† and Pasteur have observed among the results of an alcoholic fermentation, I have not taken pains to observe, for it presented no particular interest to the main question with respect to the object I had in view.

The solution No. 2, containing the carbonate of lime, indicated apparently little change during the first two or three days, and then became partly covered with a filmy mould, and evolved large quantities of carbonic acid, even after two weeks' keeping. The evolution of this gas kept on in No. 2 three weeks longer than in No. 1. The carbonate of lime, which, during the first weeks, was partly kept in suspension within the liquid, and thus only loosely covered the bottom of the flask, settled afterward in a compact mass. As soon as no further changes were apparent, I separated the liquid part by filtration, leaving upon the filter the excess of carbonate of lime employed and the crystallised part of the new compounds formed during the period of fermentation. The filtrate subjected to distillation (like No. 1) gave an alcoholic liquid of 110 grms., equal to 7 Richter at 16 Cels., containing free acetic acid, equal to 0·6190 grms. of acetate of soda. The remaining non-volatile

† "Annal. of Liebig and Wöhler." 1863. April No., p. 126.



residue of the filtrate formed, after cooling, a solid crystalline mass, consisting of acetate of lime with a small quantity of lactate of lime. The compounds of lime left upon the filter, as mentioned previously, were carbonate of lime (excess taken) and lactate of lime. All the sugar was changed into alcohol, acetic acid, and lactic acid, equal to 16.79 grms. of acetate of lime, and 19.5 grms. of lactate of lime. Two different processes had here been going on, to a certain extent, simultaneously. The rapid evolution of carbonic acid was chiefly due to the carbonic acid of the carbonate of lime, while the free acetic acid, in spite of an excess of chalk, may partly be owing to the presence of alcohol. In the presence of carbonate of lime a total destruction of the grape sugar had consequently taken place. These two experiments illustrated strikingly the serious changes which, in the course of the manufacture of cane sugar, may result from an imperfect removal of fermentation favouring compounds in consequence of the inefficiency of a boiling heat to arrest their influence. The worst feature of these fatal consequences is, undoubtedly, the change of cane sugar—namely, its transformation into grape sugar, which goes on very rapidly, and that from the fact of its not being suspected by a superintendent unacquainted with the nature of cane sugar, and measures for checking these serious influences not usually being resorted to till too late, if at all.

A quantity of the same ferment as used for the experiments just described, caused, after being dried at 60°—80° Cels., no alcoholic fermentation. Kept at 20° Cels., it soon evolved a putrid odour; yet it gave rise, although slowly, to fermentation, even after ten days. Equal weights of caustic lime and fresh ferment added successively, and in the order above mentioned, to a solution of cane sugar had no effect upon the latter. After being kept at 20°—22° Cels. for several days, the cane sugar could be separated unaltered. I repeated all these experiments, substituting in every case caustic magnesia for caustic lime, and found that the difference between those oxides of alkaline earths manifested itself merely by a different intensity of action. In some instances it appeared to me that their effect corresponded with their degree of solubility in sugar solutions. Thus, for instance, a sufficient amount of caustic magnesia prevents, if thoroughly mixed, the putrid odour of the ferment; yet in cases where equal quantities of caustic lime and caustic magnesia had been applied, the former had always entirely destroyed the fermenting power of the original ferment, while caustic magnesia only partially produced the same effect. Caustic magnesia destroyed far less rapidly the grape sugar; it retarded fermentation to a considerable degree, precipitated largely nitrogenous matters, yet acted slowly in their final decomposition. All these qualities render caustic magnesia far better fitted, as it appears to me, for the refining of raw sugar than for the defecation of raw juice, at least in the tropical climes. The very property of the caustic magnesia which causes its insufficiency for defecation in these localities are, in my opinion, its best recommendation for refining purposes.

The results stated tend to establish the fact that caustic lime must be considered the most efficient of the two basic oxides, particularly so if we adhere to the supposition that the change of cane sugar, and its consequent waste by fermentation, are the most serious features in the manufacture of cane sugar from sugar cane. An examination of the Cuba melados, resulting from the defecations carried out by different quantities of caustic lime, has confirmed me in this opinion. The

large percentage of molasses in general made in the plantations, as well as the difference in the relative percentage of the various qualities of sugar, even by pursuing the same system of manufacture with an equally complete set of apparatus, seems to speak in favour of my views of the stated question. Numerous investigations on colonial melado and molasses—for instance, W. Stein's †—furnish not less abundant facts, proving the large degree of waste of cane sugar by its transformation into grape sugar, for the latter can, under the best circumstances, only benefit the molasses at the expense of the cane sugar.

When I have argued thus far against an unconditional and exclusive substitution of caustic magnesia for caustic lime in the tropical climes, I probably need not say that I always had in view a judicious application of the lime, assisted at the same time by a careful management of all the various processes connected with the manufacture of raw sugar. An excess as well as a deficiency of caustic lime is accompanied with serious results; yet, if I had to choose, I would always be in favour of an excess, within a certain limit, rather than of the least deficiency. For, as far as the slight excess of caustic lime is concerned, a serious depreciation of the sugar obtainable may be prevented by changing the subsequent treatment of the defecated cane juice or the syrups, while in the latter case quality and quantity will suffer beyond hope. After a careful study of the present methods of manufacturing sugar by improved apparatus, as I had an opportunity of witnessing on a certain class of plantations in Cuba, I arrived at the conclusion that, probably with little expense for apparatus, labour, &c., some of the disadvantages arising from the use of caustic lime for the purpose of defecation might be successfully removed, and thus its superior energetic action in the preservation of the cane sugar advantageously secured. My proposition is, in short, to apply a sufficient amount of caustic lime, so as to secure a slight alkaline reaction in the juice passing for the first time from the (coarse) bone-black filter. Then to concentrate the once filtered juice, if possible, under exclusion of air, by well-regulated heat, discharging the syrup after it has reached 25°—26° Baumé into a serpentine or suitable copper pan, and to add, in a well-divided stream, a sufficient amount of a diluted solution of super-phosphate of lime to neutralise the free caustic lime. Immediately after this object is accomplished, I would raise the mixture rapidly to its boiling point, remove the unavoidable slight excess of acid phosphate by an excess of caustic magnesia, and keep it boiling before filtering in presence of the latter for ten to fifteen minutes. The excess of caustic lime will thus be precipitated, a further serious increase of colour avoided—for caustic magnesia is only slightly soluble in a solution of sugar—and the original colour of the syrup will be rather improved. Large quantities also of impurities of different character will be rendered insoluble, no soluble compounds of any practical consequence added, and still the so-highly desirable slightly alkaline reaction (of less serious consequences) during the progress of the succeeding operations will be restored. One or two sets of common leaf or bag filters, such as are commonly used in sugar refineries, are sufficient to filter rapidly a solution of 15,000 to 20,000 lbs. of sugar.

The effects of caustic magnesia for similar purposes in manufacture are so well and favourably known that the proposition to introduce it as an auxiliary means for

† Dingler's Polytech. Journal, xlii., p. 391.



defecation, and particularly as a most efficient means for the refining of raw sugar, cannot appear strange. I consider caustic magnesia, in consequence of my own experience during my occupation as a practical sugar refiner, a very excellent means for the clarification of the raw sugar and of the syrups for purging. Its scarcity for such technical purposes as those commented on appears to be a principal cause of its high price. Raw material for the manufacture of magnesia, as Mr. Kessler very judiciously remarks, abounds in almost every country. Nothing, in fact, remains to be done but to create a demand.

## PHARMACY, TOXICOLOGY, &c.

### *Alcohol as a Test for Croton Oil.*

MR. R. WARRINGTON, F.R.S., has published in the *Pharmaceutical Journal* some experiments on the British Pharmacopœia test for croton oil, which have led him to conclude that the use of alcohol as a test for the purity of the oil is of no value. His own opinion, he states, is that freshly expressed oil, or rather oil expressed from *fresh* seeds, either abroad or in this country, does not dissolve in alcohol sp. gr. .794—.796 to a greater extent than 20 per cent. at 50°; but that if croton oil has undergone a chemical change, such as resinification or oxidation by time and exposure to air, or has been expressed from seeds which have become changed in the same manner, then the oil is freely dissolved by the alcohol. It follows that "a test which is open to many weighty objections, both from the influence of small fluctuations of temperature, and for indicating the purity of a material liable to such marked differences from the effects of such natural, and in some cases inevitable chemical changes is perfectly useless as a reliable indication of purity."

### *On Hoffmann's Test for Phosphorus, and the Formation of Hyposulphurous Acid, by A. FROEDHE.\**

L. HOFFMANN'S method of detecting phosphorus in cases of poisoning, with some remarks, will be found at page 164, vol. vii., of the *CHEMICAL NEWS*. "The process consists in distilling from the viscera, mixed with sufficient water and a small quantity of dilute sulphuric acid, about two drachms of fluid, mixing a few drops of sulphide of ammonium with the distillate, and evaporating the whole to dryness on a porcelain dish. If phosphorus were present in the viscera, even in the most minute quantity, a drop of the solution of perchloride of iron will produce a deep violet and brownish evanescent reaction." This reaction is now explained by Froedhe as the consequence of the formation of some hyposulphite of ammonia on the evaporation of sulphide of ammonium to dryness.

## PROCEEDINGS OF SOCIETIES.

### GEOLOGICAL SOCIETY OF GLASGOW.

DR. A. T. MACHATTIE, F.C.S., delivered a lecture *On Metamorphism, with Special Reference to the Chemical Changes in Rocks.* Dr. Machattie, after some introductory remarks, said:—Let me remind all that, so far as we know, the earth is no heavier now than at its creation, so that all changes have been effected in matter existing indestructibly throughout every stage of our world's

history. All the rock masses of our earth are either the original rocks or they have been produced from the disintegration of those that have preceded them. It is therefore obvious that, if we trace back, we must arrive at certain rocks which have not been produced from others—that is, there must have been some original rock or rocks of one kind or another, although it does not follow that there is any of these still in existence. Such considerations bring us to the necessity of forming some conclusions on the original condition of the earth, or rather, the condition of the earth before what we properly term *rocks* were formed.

Many phenomena lead us to conclude that the earth was once in a molten state:—1. The shape of the earth is that which would be taken by a rotating liquid mass; 2. When we descend into the crust of the earth by pits, wells, &c., the temperature invariably rises about 1° F. for every fifty or sixty feet; 3. Volcanoes eject molten minerals, which require the highest temperature of our furnaces for their fusion; and 4. The density or specific weight of the earth being unaccountably low, on the supposition that the earth is solid throughout, leads us to the belief that the central portions must be greatly expanded or rarified; and we know of no expansive force except heat. The prevalent opinion is, that we stand upon a hard crust which has cooled, and this crust we have for examination, together with anything which active volcanoes may throw out from lower depths for our inspection—that is, lavas and volcanic products generally. We might expect the original rocks (if they exist now) to be lowest, and as in all cases where geologists have been able to penetrate the upper rocks, the last rock which they encounter is granite, it has usually been assumed that granite is the oldest rock. It was at one time, indeed, considered the original cooled crust, but now it is not even believed to be the oldest rock with which we are acquainted; in fact, we have granite of all ages.

There are four methods by which rocks may now be produced:—1. Volcanoes may eject *igneous* rocks; 2. The surface of the earth may be altered by certain mechanical and chemical agencies—*e.g.*, water and the constituents of the atmosphere; 3. Remains of plants may give rise to coal; 4. Air may blow sand or finely-divided matter into heaps, which afterwards consolidate. If the earth was once molten, all rocks must either be themselves igneous or they must have been produced at once, or by successive stages from igneous rocks. The only rocks which we know to be of igneous origin are the so-called trappean and volcanic rocks. These contain all the elements of the stratified rocks, and I now pass to consider the manner in which igneous rocks become decomposed or broken up. Water, in freezing, expands in the pores of rocks and splits the mass into fragments. Water also washes away fine powder of any kind. Those agencies which act chemically are the oxygen and carbonic acid of the air, and, to a less degree, water. Oxygen combines with the iron of igneous rocks, and converts it into rust or oxide of iron. Carbonic acid, when in water, dissolves out the lime and converts it into carbonate of lime, for the further production of limestones, marble, calcite, arragonite. Water may combine with the products of such changes, as when carbonate of iron becomes, by oxidation and hydration, the hydrated peroxide of iron or brown hæmatite. When acted on as above, the constituents of igneous rocks are carried off and deposited under various conditions, forming the different kinds of limestones, clays, sandstones, and stratified rocks in general.

The metamorphism which we shall principally study at this time is accompanied by chemical change, or change in composition. When chalk becomes marble, or sandstone passes into quartzite, no difference of composition is observable, although these are instances of very decided metamorphism. We cannot, however, altogether avoid reference to this kind of change, but we shall

\* *Annalen der Chem. und Pharm.*, bd. cxxx., s. 127.



first observe certain results which may follow chemical metamorphism. Chemical metamorphism may result in (1) a mere re-arrangement of the elements which compose any rock, so as to produce new chemical compounds, without altering the ultimate or elementary composition of the rock changed. For example, a rock containing two compounds, AB and CD, might have these rearranged as AC and BD; (2) the change may involve a loss of constituent matter, as when by loss of water clay becomes slate; (3) the change may consist in the addition of new matter, *e.g.*, when anhydrite by combining with water becomes gypsum; (4) we may have metamorphism produced by loss of some constituents and addition of others, the kind of change, as might be anticipated, by far the most frequent.

Before referring to the causes of change in matter, we shall shortly glance at the nature of the matter itself. It is surprising how few of the elements form the great bulk of unstratified and stratified rocks. Of the whole sixty-four or sixty-five elements in nature, only twelve may be said to enter largely into the formation of rock masses. Six of these are metals—potassium, sodium, calcium, magnesium, aluminium, iron. Six are non-metals—hydrogen, oxygen, carbon, silicon, sulphur, and chlorine. The relation which these twelve elements bear to the other fifty-three, so far as quantity is concerned, may be likened to the relation borne by the foundations and massive walls of a house to the ornaments with which these walls may be decorated. The twelve abundant elements occur in nature chiefly in a state of combination with one another, and the principal compounds which are produced by their union are water (hydrogen and oxygen), carbonic acid (carbon and oxygen), silica (silicon and oxygen), sulphuric acid (sulphur and oxygen), common salt (chlorine and sodium), and potash, soda, lime, magnesia, alumina, which are the oxides of the metals potassium, sodium, calcium, magnesium, and aluminium respectively. Lastly, we have iron and oxygen combining to form the different oxides of iron. Of these compounds the great bulk of the crust of the earth is composed. Granite contains the twelve elements referred to above, with the exception, perhaps, of any notable amount of hydrogen, carbon, and chlorine; but as hydrogen is one of the constituents of water, carbon exists in the atmosphere, and chlorine is one of the elements of common salt, we may say, practically, that in a granite earth, surrounded by a salt ocean, and an atmosphere such as we now breathe, we have everything necessary for the formation of all the known stratified rocks. It is no wonder, then, that granite has been so long considered the great storehouse of raw material, from which the earth's crust, as we now find it, has been slowly elaborated by the operation of air, water, and the great forces of nature.

In returning to the various results of metamorphism already alluded to, it is clear that the first kind of change, that in which mere re-arrangement occurs, may be expected to occur only in rocks of a complex constitution, for, in more simple cases, change of form or aggregation may occur, but not of composition. Silica, for example, if taken alone can never produce or become anything else but silica, and the same remark applies to carbonate of lime. Limestone, marble, calcite, and arragonite may be different in appearance and in other properties, but chemically they are identical. In the case, however, of a complex rock, such as clay slate, containing silica, alumina, oxide of iron, lime, magnesia, potash, &c., instances are recorded in which it passes into gneiss, in which latter rock the elements are arranged very differently, yet the clay slate and gneiss may have the same composition when analysed.

Changes accompanied by loss of matter are of considerable importance. Clay, by loss of water, becomes slate. Coal, when heated by the intrusion of trap, passes into

coke from a loss of bituminous matter. It is evident further, from what we know of the mechanical action of water, and the solvent power of water, containing carbonic acid, that metamorphism, with loss of ingredients, must be very frequent, although for the most part it is impossible to trace back to their sources and prove that materials once carried away in solution or suspension have been derived from any particular rocks. The simplest cases of metamorphism, by increase of matter only, are obviously just the converse of those mentioned under the preceding kind of change—that is to say, that instead of loss of water we have addition of, or combination with, water. Thus, anhydrite becomes gypsum; red hæmatite becomes brown hæmatite, and so on with other hydrated minerals. Such cases only require for their explanation the presence of water—a condition which is admitted to be almost of universal occurrence. The metamorphism in which both loss and gain is evident is very frequent, and is by far the most important kind of change. It involves all the different phenomena and causes of metamorphism, and merits a somewhat full treatment.

There are a considerable number of well-known rocks occurring in immense quantities, and bearing such striking evidence of change, that geologists have for a long time termed them “metamorphic rocks.” It will be understood by all those acquainted with the barest elements of geology that I now refer to such rocks as quartzite, hornstone, clay slate, mica schist, chlorite schist, talc schist, hornblende schist, and gneiss; also, primary and crystalline limestones generally, marble and dolomite. If we disregard quartzite and hornstone, and limestone, we shall have left a series of metamorphic rocks which in composition present remarkable similarity. Clay slate, gneiss, and the various schists contain almost exactly the same ingredients, although the preponderance of individual compounds in each rock confers on it certain specific and distinguishing characteristics. Gneiss is generally considered an excellent example of the more complete stages of metamorphism, in which the changed rock still retains evidence of stratification or aqueous deposition. Its composition is similar to that of clay slate; the arrangement of their ingredients is very different. Gneiss may be stated to contain the crystalline ingredients of granite in a stratified form; and just as we have granite consisting of quartz, feldspar, and mica, in an unstratified condition, so we have gneiss, made up of quartz, feldspar, and mica, in a stratified form; and corresponding to the varieties of granite called syenite and protogine, in which the substitution of hornblende and talc respectively for mica constitutes the specific character, we have varieties of gneiss which are called hornblendic (syenitic) gneiss and talcose gneiss, from the presence of the minerals hornblende and talc, here substituted for the mica of gneiss proper, precisely as in the case of true granites.

The appearances which induce us to consider rocks metamorphosed are chiefly induration, foliation, crystallisation, and various kinds of contortion. The question how, or by what agencies, these results have been brought about, may be answered in two ways: first, we know with tolerable definiteness what forces are at work in nature; and, secondly, we can produce the characteristic appearances and changes artificially to a greater or less extent. Some of the simpler results of metamorphism may be produced by long-continued heat; for example, the conversion of sandstone into quartzite. Heat, accompanied by pressure, may change clay into slate, and chalk into marble; but the great family of schistose rocks have been produced, in all probability, by more complicated means than heat and pressure. That the schistose and crystalline rocks have been formed from ordinary stratified rocks is presumed for the following reasons:—(1.) The similarity of composition between them and ordinary argillaceous deposits. (2.) The presence in schistose rocks of fossils, the structure of which is perfect or uninjured. (3.) Some schists



contain carbonaceous matter (apart altogether from carbonates), the presence of which can only be accounted for on the supposition that the remains of plants or animals were imbedded in the rocks during deposition. (4.) The actual passage of a common stratified rock into a crystalline and schistose one is frequently observed. The above arguments not only prove the source of schists, but also throw some light on the mode of their formation. The presence of uninjured fossils puts fusion out of the question, and, accordingly, we have to decide how crystals can be formed in a rock without fusion or aqueous solution. That they can be so formed is undoubted. Crystals, with our present knowledge, cannot be considered as unmistakeable evidence either of fusion or solution.

On the supposition that clay is the source of the principal metamorphic rocks, synthetic experiments have been made on clays by heating them under pressure with water containing alkaline silicates in solution, and by this means certain important results have been obtained. Perfect crystals of quartz, feldspar, mica, and pyroxene have been formed in these experiments at a red heat. Wood has also been converted into anthracite, with the simultaneous production of oils having all the properties of natural petroleum. Further, vitreous or glassy obsidian has passed into a highly crystalline trachyte.

The arguments in favour of the action of heated water under pressure, sometimes called "hydrothermal" action, as a metamorphic agency are chiefly these:—1. Metamorphosed rocks are seldom uniform in structure, and whilst fusion almost implies uniformity, the action of superheated steam does not. 2. The crystalline minerals can be produced by "hydrothermal" action at a much lower temperature than their fusing point. 3. Quartz is almost universally present in metamorphic rocks, and quartz is a constant product of the action of superheated water on silicates on the small scale. Moreover, fused quartz or silica has a specific gravity on cooling of 2.3 (water = 1), and fused quartz has never yet been found to crystallise when cooled. The metamorphic rocks contain, on the other hand, crystallised quartz, having a specific gravity of 2.6. The quartz produced by "hydrothermal" action is crystallised, and possesses the specific gravity of 2.6—that is, it is identical with that found in natural metamorphosed rock masses. 4. Water is found in all rocks.

That a perfectly crystalline structure may be developed without fusion is well known: vitreous arsenious acid becomes crystalline on exposure to the air for some time, so does vitreous or barley sugar. The fibrous wrought-iron of railway axles is also capable of assuming a crystalline structure.

The sum of these remarks seems to be this—that heat, pressure, and water can, together, produce those effects which are characteristic of the schistose and other metamorphic rocks. In this statement I include gneiss, because, although the similarity between granite and gneiss has given rise to the belief that gneiss is composed of disintegrated granite, this similarity may be turned to prove that granite is metamorphosed gneiss. For, although it may be admitted that when any metamorphic rock contains minerals similar to those found in granite, this argues similarity in their mode of formation, and so long, therefore, as we consider granite of igneous origin we must admit the probability of the same origin for the other; yet as we know of certain rocks which contain granitic minerals, and yet which have been produced with the intervention of water, this would argue that the formation of granite involves the presence of water too; but into this question I cannot now enter.

Besides the agencies supposed to have combined to produce the schistose metamorphic rocks, we have certain minor causes of metamorphism, such as mixture of contiguous rocks; double decomposition, as in the formation of some dolomites where sulphate of magnesia may be

supposed to react on carbonate of lime, producing sulphate of lime and dolomite, and lastly, volcanic exhalations.

In conclusion, let it be remembered that the various causes of metamorphism referred to are quite legitimately used to explain the results. Heat, pressure, double decomposition, aqueous solution, mixture of contiguous matter, and volcanic exhalations, are not imaginary. If we reflect on what the condition of rocks a few thousand feet beneath us must at all times be, we shall be reminded of the constant action of heat and pressure under all the surface of the earth. Water with its mechanical and chemical effects is even now everywhere at work. Double decomposition, mixture of matter in contiguity, and the influence of volcanic exhalations, are processes the action of which may be verified by any one at any time. Metamorphism, then, considered in the sense in which we have been studying it, is a series of alterative processes—slow, gradual, and continuous, such as we now find going on around us in the mineral matter of our globe. The explanations given of the changes observed in the rocks of the earth's crust are such, therefore, as commend themselves to those who would judge of the past by the present, and read the history of our planet by the light of acquired knowledge or experience.

#### ACADEMY OF SCIENCES.

January 23, 1865.

M. CORENWINDER communicated a memoir "*On the Chemistry of Beetroot.*" The author has analysed a number of roots grown with different kinds of manure, and found the sugar to vary from 5 to 14 per cent. In the ashes the only thing remarkable noticed was the fact that carbonate of soda sometimes completely replaced carbonate of potash, but in these roots the sugar was always low.

Another memoir read was by M. H. Marés "*On the Production of Manure by Sheep: the Relation between the Manure Produced and the Food Consumed.*" The author made three experiments, and in two fed his sheep on materials not at the command of English farmers—namely, the marc from the wine presses and mulberry leaves. We need not notice the results with these; but in a third experiment he fed with lucerne alone, and with this he made out that 82 per cent. of the nitrogen in the plant passed into the manure dropped.

M. Jullien contributed some "*New Facts on Cast Irons and Steels.*" The author has adopted Karsten's views of the constitution of cast iron, steel, and alloys, but modifies them by asserting that metals do not combine with one another, but one metal dissolves in another. The object of the long memoir presented to-day is to demonstrate—1st, that metals do not combine with each other; 2nd, that iron does not combine with either carbon, silicium, or nitrogen; and 3rd, that a mixture of hydrate of lime and dry hydrated sulphate of soda presents all the characters of a solution, but none of those of combination. M. Jullien then gives us his ideas on the constitution of irons and steels in a series of propositions, of which we have only space for one or two. Liquid cast iron, he says, is a solution of liquid carbon in liquid iron. Soft steel is a solution of amorphous carbon in either amorphous or crystallised iron. Grey pig, obtained by casting in hot moulds or sand, is a mixture of graphite and steel, the components, iron and carbon, being both in the amorphous state. We will quote one more assertion. Graphite being amorphous, carbon cannot crystallise without becoming diamond; the supposed crystals of graphite are really casts of other crystals. The author then gives some other consequences which flow from his theory. Liquid glass, he says, is the solution of a neutral silicate in one of its components. Granite is a liquid glass cooled slowly. Lava, liquid glass cooled suddenly. Bronze cooled slowly, a solution of crystallised tin in amorphous copper. Bronze cooled suddenly,



a solution of amorphous tin in amorphous copper. Red phosphorus is the amorphous condition of an allotropic state of phosphorus, the crystalline form of which is not yet known.

MM. Boivin and Loiseau presented another note "*On the Sucrates of Lime*." The authors are still occupied with the bibasic sucate; and the fact of capital interest in the paper is the remark that to remove the lime from solutions in sugar plenty of carbonic acid must be employed.

M. Kekulé presented a note "*On the Atomic Theory, and the Theory of Atomicity*." All that M. Kekulé says on this subject is worthy of attention, and we shall give in another place a longer abstract of his paper than we could here.

M. Terreil communicated "*Analysis of a Bronze and an Iron Ore*" found in one of the bone caverns of Perigord. The composition of neither presented anything remarkable.

M. Faye read the second part of his memoir "*On the Physical Constitution of the Sun*;" and a communication on the same subject was received from M. Chacornac. We have said that M. Faye regards the sun as a fluid mass undergoing a gradual cooling; and upon this assumption he explains all the solar phenomena. We are not certain that we rightly understand the author; but we fancy he believes the sun to be still in a liquid state—a state which, he says, is purely transitory; but he comforts us with the assurance that the next stage, in which the whole of the mass will contribute to the emission of light and heat, now only effected by the photosphere, will last millions of years; and therefore we may thank God that the whole creation is not threatened with speedy extinction.

## NOTICES OF BOOKS.

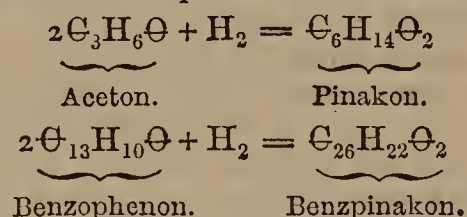
*Annalen der Chemie und Pharmacie.* January, 1865.

THE first paper is by Linnemann, "*On Benzophenon and Some of its Derivatives*." Benzophenon,  $\text{C}_{13}\text{H}_{10}\text{O}$ , is obtained by the dry distillation of a mixture of benzoate of calcium and caustic lime. The distillate is a mixture of benzole, bitter almond oil, benzophenon, and other matters. The first can be removed by evaporation on a water bath, and then, after repeated distillations, a yellow oily fluid is obtained, which, on cooling, settles into a mass of crystals. A brown liquid is separated from this by pressure between folds of blotting-paper, and now, by solution in hot spirit of wine and one or two recrystallisations, benzophenon is procured as a snow-white crystalline mass composed of fine long needles, or if deposited from a hot saturated solution, in the form of glistening prisms. With bromine benzophenon forms a tri- and also a pentabromated compound. By treatment with sodium amalgam it furnishes a peculiar body, which the author has named *Benzhydrol*— $\text{C}_{13}\text{H}_{12}\text{O}$ . Benzhydrol has some of the properties of a monatomic alcohol, but does not yield an aldehyde; oxidising agents simply re-convert it into benzophenon. Benzhydrol dissolves in fuming nitric acid, a lively reaction ensues, and an oily body is produced, which, on separation and solution in alcohol, gives buff-coloured needles of *binitrobenzophenon*— $\text{C}_{13}\text{H}_8(\text{NO}_2)_2\text{O}$ . By chromic acid, as before hinted, benzhydrol is re-converted into benzophenon. In this way its behaviour resembles that of acetone, which is, by the action of sodium amalgam, converted into isopropyl alcohol, from which oxidising agents reproduce acetone. With bromine benzhydrol yields bibromated benzhydrol, thus differing in its behaviour from a normal alcohol. By sodium amalgam benzhydrol is reproduced from this compound. The author then gives an account of some ethers of benzhydrol, which is remarkable for its ready etherification. Benzhydrol ether is obtained by the simple distillation of benzhydrol, or even by allowing to stand for several hours at a weak heat. Mixed ethers of benzhydrol and methyl or ethyl-alcohol are formed at a moderate temperature, when

a solution of benzhydrol is added to a mixture of either of the above alcohols and sulphuric acid. Acetic, benzoic, and succinic ethers are formed by simply melting the acid with the alcohol.

We must refer the reader to the original paper for the full account of these bodies, but may mention some peculiarities of the *ethyl-benzhydrol ether*. This is immediately after distillation a colourless, odourless, and strongly refractive liquid of the consistence of glycerine. In a very short time after distillation, if exposed to the light, it becomes coloured, and then appears green by reflected and pale yellow by transmitted light. The colour disappears when the substance is gently heated, or shaken, or even put in a dark place, and is again coloured on exposure to light. On keeping for some months, it becomes insensible to light, and after a re-distillation, never again acquires its sensibility. The acetic ether possesses similar properties.

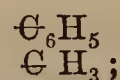
Passing from the ethers of benzhydrol, we may shortly notice the behaviour of benzophenon with zinc and sulphuric acid. The product of this reaction extracted by alcohol and purified by several re-crystallisations, showed, on analysis, the composition  $\text{C}_{26}\text{H}_{22}\text{O}_2$ . This body the author compares with that derived from acetone, and accordingly names it *benzpinakon*. Thus—



Oxidising bodies re-produce benzophenon from benzpinakon. Sodium amalgam seems to effect no change in the chemical composition of benzpinakon, but alters its physical character, and the author names the new product *isobenzpinakon*. The former crystallises in white transparent prisms, the latter is a thick, colourless, syrupy, strongly refractive liquid.

The author returns to the curious fact that benzophenon forms very different compounds with hydrogen from an alkaline solution and hydrogen from an acid solution, and mentions that acrolein behaves in a similar manner.

The next paper is by F. Beilstein, "*On Xylol*." Toluol has been found to be identical with the mixed radical methyl-phenyl,



and it has been conjectured that xylol might be identical with ethyl-phenyl. This, however, has been shown not to be the fact. The author prepared his xylol from coal-tar oil repeatedly treated with sulphuric acid and soda ley, and lastly by the addition of sodium, until that metal remained perfectly bright. He then distilled and collected what he finds to be pure xylol at  $141^\circ$ . Mansfield on fractionating coal tar noticed that the thermometer became stationary from  $80^\circ$  to  $85^\circ$  at  $113^\circ$ , from  $143^\circ$  to  $145^\circ$ , and from  $170^\circ$  to  $172^\circ$ . The experiments of Ritthausen and Hildenkamp gave closely concordant results. These agree with the boiling points of the following compounds:—

Benzol, $\text{C}_6\text{H}_6$	.	.	.	.	$82^\circ$
Toluol, $\text{C}_7\text{H}_8$	.	.	.	.	$111^\circ$
Xylol, $\text{C}_8\text{H}_{10}$	.	.	.	.	$139^\circ$

Mr. Church has given the boiling points of the benzol series in the following table, which is to be found in most manuals:—

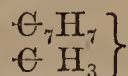
Benzol, near	.	.	.	.	$80.8^\circ$
Toluol	„	.	.	.	$103.7^\circ$
Xylol	„	.	.	.	$126.2^\circ$
Cumol	„	.	.	.	$148.4^\circ$
Cymol	„	.	.	.	$170.7^\circ$

Beilstein supposes that Mr. Church's products were not sufficiently fractionated, or that he operated upon an insufficient quantity of coal-tar oil.

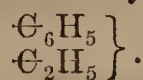


The author then gives an account of xylo-sulphuric acid and some of its salts, and afterwards a description of the product of the oxidation of xylol by sulphuric acid and bichromate of potash. This is *terephthalic acid*,  $\text{C}_8\text{H}_6\text{O}_4$ , the salts of which are next described. The acid is identical with that obtained by Dr. Müller by the oxidation of cummin oil by chromic acid. The nitro derivatives of xylol are next described, and lastly we have an account by Wahlforss of the action of bromine on xylol.

A short paper by Rudolph Fittig gives a preliminary notice of "*Methyl-benzyl*." This he has prepared by submitting a mixture of bromated toluol and iodide of methyl to the action of sodium amalgam. The result is methyl-benzyl,

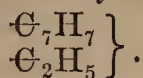


a very different body from methyl-phenyl,



The former body boils at  $139^\circ$ , or six degrees higher than the phenyl compound. The sulpho acid and the nitro compounds differ from those of xylol mentioned in the foregoing paper.

Fittig has also prepared ethyl-benzyl,



It boils at  $159^\circ$ , and shows no resemblance to cumol.

The same author has a short paper "*On the Behaviour of Monochlorated Benzol to Alcoholic Solution of Potash*," in which he asserts that no phenol is produced by the reaction of the two bodies.

The next paper, by Riche and Berard, "*On the Bromine Derivatives of Benzol and its Homologues*," we have noticed before.

An article by Dr. Rautenburg, "*On the Estimation of Urea and Ammonia*," gives a modification of Liebig's process for urea, which we shall extract at length.

The next paper is by Heintz, "*On the Ethyl Derivatives of Hydantoin and the Formation of Hydantoinic Acid from Glycocoll*."

After some other extracted articles, we find one by Bünsen, "*On the Extraction of Thallium from the Mother Liquors of Sulphate of Zinc*." While flue-dust is to be had, no other commercial source of thallium is worthy of notice. The presence of the metal in these mother liquors might have been anticipated.

"*On some Derivates of Aceton and its Conversion into Allyl*" is the title of a paper by Borsche and Fittig, in which they notice the chlorinated compounds of aceton, and show how allyl is produced from some of them.

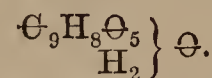
Liebig's note on "*Extract of Flesh*" also appears in this journal; and then we have some short preliminary communications by Linnemann. The first is "*On the Behaviour of Acrolein to Hydrochloric Acid and Zinc*." It forms a mixture of allyl and propyl alcohols, and a third body  $\text{C}_6\text{H}_{10}\text{O}_2$ . The second gives the "*Behaviour of Bromine to Propyl Alcohol*." There is formed a mixture of bromide of propyl, bromoform, and other bodies containing bromine, among which are found the bromine substitution products of aceton. Bromhydrin is not found. Bibromated propyl, by treatment with moist oxide of silver, gives a brown, weakly acid, syrupy liquid, which, on distillation with acid sulphate of potash, gives acrolein, and, by treatment with iodide of phosphorus, gives iodide of allyl. Glycerin also is formed.

The last paper in this unusually interesting number of the *Annalen* is one we have already noticed in the proceedings of the French Academy.

*Bulletin de la Société Chimique de Paris*. December, 1864.

THE proceedings of the Chemical Society of Paris are of less interest to us than they should be, seeing that by

far the greater number of papers read before the Society are contributed to the Academy of Sciences, and, therefore, published in the weekly *Comptes Rendus*, while the *Bulletin* only appears once a month. Among the original papers we find one by M. Lauth "*On Aniline Black*," a full abstract of which we shall give in our next number. Another paper is by Schaller "*On the Preparation and Formula of Carminic Acid*." The author's mode of preparation is the following:—An aqueous solution of cochineal is treated with acetate of lead and a little acetic acid. The precipitate is collected on a filter and washed, and then decomposed by sulphuric acid. The filtrate from the sulphate of lead is treated a second time in the same way, taking care to have no excess of sulphuric acid. After the second or even a third treatment the carminate of lead is decomposed by sulphuretted hydrogen, and the solution of carminic acid is evaporated to dryness. Solution in alcohol then frees it from all mineral matters. On concentrating the alcoholic solution some mammellar yellow crystals are deposited along with the carminic acid. They may be removed by a washing with cold water, and the carminic acid may then be re-crystallised from alcohol or ether. The author's analyses lead to the formula  $\text{C}_9\text{H}_{10}\text{O}_6$ . Carminic is a bibasic acid, and, therefore, its formula may be written



The analysis of memoirs on pure and applied chemistry, which, as usual, accompanies the *Bulletin*, is very full of interesting matter, and we shall largely avail ourselves of its contents.

## NOTICES OF PATENTS.

1285. *Protecting the Bottoms and Sides of Wooden and Iron Ships and other Submerged Structures*. C. P. COLES, Southsea. Dated May 21, 1864.

As a protection from the barnacles, Captain Coles proposes to cover the bottom of his cupola ships, as well as those of timber construction, with stucco, plaster, or hydraulic cement, first driving iron nails into the hull to assist the adhesion of the latter, and in the case of iron vessels applying a thin sheathing of wood underneath the plaster.

1286. *Apparatus for Increasing the Illuminating Power of Gas, and for Producing Gas by the Vaporisation of Hydrocarbons and Essences of Petroleum*. R. A. BROOMAN, Fleet Street, London. A communication. Dated May 21, 1864. (Not proceeded with.)

THE apparatus herein described is intended to fulfil the purposes of a carburetter, and of a gas generator. It consists of a strong metallic vessel in the form of a double cylinder having one portion superposed, which serves as a reservoir for the petroleum or other hydrocarbon, and the lower cylinder is employed as a vaporiser.

1270. *Improvements in Treating Oil and Spirit Varnishes, and also Drying Oils and Turpentine, in order to Bleach and otherwise Improve the same*. J. E. G. FREEMAN and C. H. FREEMAN, Battersea. Dated May 19, 1864.

THE oils and varnishes about to be treated according to this process are allowed to stand at rest for two or three months, or until all matters in suspension have subsided, they are then racked off into bottles or other vessels capable of being closed perfectly air tight; these bottles should be only half filled with the oil or varnish, and then the air remaining above is replaced by pure oxygen gas. The stoppers having been securely fastened, the oil or varnish is agitated in contact with the gas, or the vessel may be kept constantly rotated. After a short



treatment in this way the oils, &c., will have become much paler in colour, and improved in other respects, particularly in their drying qualities.

It is not easy to perceive in what manner oil of turpentine can be improved by this method of treatment, for by the absorption of oxygen it must become more highly charged with resin, and so far deteriorated. The mixture of hydrocarbon vapours and oxygen contained in these bottles would be possessed of highly explosive properties in the event of its meeting with flame.

1296. *Obtaining Sulphur from Alkali or Blue Waste.* B. JONES, Warrington. Dated May 25, 1864.

THE inventor liberates the sulphur from combination with calcium and its salts by operating upon them with high pressure steam in the presence of water, using for this purpose a closed iron vessel called a digester.

1320. *Improvements in Lamps, Vessels, Tubes, and Cocks, especially Useful for Preventing the Transmission of Flame or Explosive Action when Using Petroleum, Camphine, &c.* J. H. BURKE, London. Dated May 27, 1864. (Not proceeded with.)

THIS suggestion refers to a novel means of producing the multitubular blocks of metal which Sir Humphry Davy and Mr. Maugham found so efficient for the purpose of cooling flame and preventing the ignition of explosive vapours. The inventor takes two strips of metal, one being plain and the other finely crimped or corrugated, and then by rolling them up tightly together forms a bundle of metallic tubes, which, being of suitable small dimensions, is very efficient as a fire-proof diaphragm in lamps and burners intended for the combustion of camphine and petroleum.

1327. *An Improved Paint.* J. THOMAS, Battersea. Dated May 28, 1864. (Not proceeded with.)

FOR the purposes of an ordinary paint as well as one which is particularly adapted to coating the bottoms of iron and timber ships, the inventor employs copper slag reduced to fine powder and mixed with oil. In this condition its colour is nearly black, but by previous calcination of the ground copper slag a red or brown pigment may be produced, and the colour may be modified by varying the temperature at which the roasting operation is conducted.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

2883. A. A. Croll, Coleman Street, London, "Improvements in the preparation of materials to be used in the purification of gas for illumination."—Petition recorded Nov. 18, 1864.

3115. W. Bardwell, Great Queen Street, Westminster, "An improved method of utilising sewage and urine, and for facilitating their passage through pipes, thereby preventing the pollution of rivers and streams."—Dec. 16, 1864.

3131. A. A. L. P. Cochrane, "Improvements in apparatus for heating and evaporating liquids and fluids."—Dec. 17, 1864.

3252. L. P. E. Max, Paris, France, "Improvements in treating oils and hydrocarbons, and in apparatus for the same and other operations in which matters have to be purified, clarified, and refrigerated or condensed." A communication from E. Laporte, Boulevard de Sebastopol, Paris.—Dec. 30, 1864.

4. E. Bevan, Birkenhead, Cheshire, and A. Fleming, Liverpool, Lancashire, "An improved jacket or protector for metallic and other vessels and structures containing solid substances, liquids or gases, to prevent radiation of heat from, or communication of heat to, such vessels and structures."—Jan. 2, 1865.

40. J. E. Vigouléte, Nelson Square, Peckham, Surrey, "Improvements in the treatment of carbonaceous minerals, and in apparatus for preparing agglomerated fuel."

50. Thomas Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, London, "Improvements in treating guano."—Jan. 6, 1865.

57. E. Beanes, Priory Road, Kilburn, Middlesex, and C. W. Finzel, Bristol, "Improvements in the construction of vacuum pans."—Jan. 7, 1865.

80. W. Clark, Chancery Lane, Middlesex, "Improvements in preparing or treating wood and other vegetable fibrous materials for the manufacture of pulp for paper." A communication from Z. Orioli, A. A. Fredet, and P. A. H. Mabussiere, Paris.—Jan. 10, 1864.

#### NOTICES TO PROCEED.

2235. A. C. Kirk, Bathgate, Linlithgowshire, N.B., "Improvements in the manufacture of ice."—Petition recorded Sept. 13, 1864.

2260. J. H. Simpson, Kilmeena, Ireland, "Improvements in printing by electricity for telegraphic and other purposes."—Sept. 16, 1864.

2278. Frederic Yates, Birmingham, Warwickshire, "Improvements in the distillation of volatile minerals, vegetable, and other organic matters."—Sept. 17, 1864.

2298. W. Lawrence, Cornwall Villas, Paddington, Middlesex, "Improvements in apparatus for mashing and for cooling worts and other liquids."—Sept. 20, 1864.

2332. W. Larcom, Gosport, Hampshire, "Improvements in protecting the sides and bottoms of ships and other structures of iron, and in materials to be employed therein."—Sept. 22, 1864.

2339. W. Palmer, Jun., Southweald, Essex, "Improvements in the manufacture of candles."—Sept. 23, 1864.

2504. H. Tucker, Newton, Mass., U.S.A., "An improved process for bronze-colouring iron."—Oct. 11, 1864.

2695. J. F. Brinjes, Fieldgate Street, Whitechapel, "Improvements in apparatus for the reburning of animal charcoal."—Nov. 1, 1864.

3207. E. Morewood, Cheam, Surrey, "Improvements in coating metals."—Dec. 24, 1864.

#### CORRESPONDENCE.

##### Continental Science.

PARIS, January 24.

IN the absence of more useful intelligence, I must give you some idea of a method of preserving beer for an indefinite period, rather vaguely described by M. Michel. Given, beer arrived at the last term of the alcoholic fermentation. M. Michel adds thereto a "complimentary ferment," which immediately precipitates everything which is capable of setting up a new fermentation, and the beer is clarified as well as preserved. What this complimentary ferment is we are not told, but we are told that it is quite innocuous, and rather "hygienic" than harmful. Perhaps some brewers of pale ale for export at Burton would be glad to get hold of M. Michel's secret, and I should be glad to experiment on some beer he has operated upon.

Your readers will rejoice to learn that M. Stas, of Brussels, has published more results of the investigations on which he is known to be continually engaged. His present instalment, read before the Berlin Academy of Sciences on January 14, is occupied with determinations of the atomic weights of silver, iodine, bromine, and chlorine, the principal object of his experiments being to ascertain whether the atomic weight of silver in combination with these three haloids is the same, and whether it agrees with Prout's law. Further than this, the indefatigable author gives new determinations of the atomic weights of nitrogen, bromine, silver, lithium,



potassium, and sodium. I will send you the entire memoir as soon as I receive it; it is entitled, "*New Researches on the Laws of Chemical Proportion, and on the Mutual Relations of Atomic Weights.*"\* Of all recent determinations of atomic weights, probably none can compare for accuracy with those of M. Stas. Your readers, however, are well acquainted with his method and appliances, and I need say no more at present.

It is difficult to be an inventor now-a-days. A man with an idea in his head must not go to sleep on it, but bring it out as soon as he can, or he is sure to be forestalled. There is M. Flandrin, for instance, who last July deposited a sealed packet with the Academy. That packet contained the suggestion of a plan for driving machinery with ammoniacal gas, starting, of course, with the liquefied gas. But during this time M. Tellier has occupied himself with the same subject, and for the last fortnight has set all Paris talking about his invention. The two inventors start from the same point. Given, a vessel of liquefied ammonia, turn a tap, and the gas escaping will drive forward a piston; this being arranged to cut off the supply of gas, and to admit some water, a vacuum is produced by the absorption of the gas, and the piston is forced back by atmospheric pressure. The thing is as simple as possible; but as only one stroke of the piston will do any work, you require a number of cylinders. With four, however, with a stroke of 0.6 of a metre and a diameter of 0.4 m., M. Flandrin says he will do the work of forty hours.

M. Tellier proposes to drive an omnibus for an hour with 10 kilogrammes of liquid ammonia, and 60 kilogrammes of water to absorb it. Of course, none of the ammonia is to be lost: the gas can be driven from the solution and condensed again ready for another start. In the hot weather perhaps it might be arranged to let a puff into the omnibus to revive the fainting passengers. The idea is an excellent one, and I should be glad to see ammoniacal omnibuses started. But while they are being built I will, instead of sending a sealed packet to the Academy, publish a suggestion for M. Lenoir. Why should he not adapt his gas engine for locomotive purposes? I, for example, should like to drive my brougham, but I wish to be independent of coachmen who want wages, who get drunk and upset one, or at least steal one's corn and maltreat one's horses. I wish also to be independent of horses who will eat, and whose insane timidity or incorrigible vice is continually bringing their owners to grief. Well, why should I not start on my day's rounds with a bag of gas under my seat, and a battery outside, and be able to replenish my gas bag, as I refresh my horses, at a stand-pipe in the street? A gas engine is quite free from the objections which have been brought against steam engines for street traffic—no smoke, and no steam escaping with a loud noise to frighten the timid horses and scare the old women who throng our thoroughfares.

I think I have informed you before that two prizes have been founded by the Dollfus family, of Mulhouse, one of which is to be allotted every five years for the most useful invention, discovery, or application in science which has been made during the intervening years, of course in relation to the manufactures of Mulhouse. The first prize was allotted at the end of last year for aniline colours; but instead of one gold medal and 6000 francs, the money will be expended on five gold medals, one to Runge, the discoverer of aniline, and one each to MM. Bechamp, Perkin, Hofmann, and Verguin, the discoverers, investigators, and, in the case of M. Verguin, we may say one of the most successful practical manufacturers of the colours. Mr. Nicholson is not so well known as a scientific man here as in London.

*The Sugar of the Future.*

To the Editor of the CHEMICAL NEWS.

SIR,—On page 299, vol. x., of your valuable paper appears, under the rubric of Continental Science, a single word about a kind of sugar termed there, as the words used by my fellow-countryman and friend, Dr. J. E. de Vry, the sugar of the future. In reply to a note from me addressed to Dr. de Vry, I received the following letter, which I translate, and request you to insert it in your next impression, as it may contain some matter of interest to some of your readers.

Dr. A. ADRIANI.

Dr. de Vry writes as follows:—"When, in the year 1857, I proceeded on my journey from Holland to Java, I stayed a month in Ceylon, and while there I became acquainted with the *Borassus flabelliformis*, vulgarly called by the Ceylonese-British inhabitants palm of Palmyra; and among other products of native industry my attention was called to the sugar sold by the natives under the name of *Jaggery*. The large number of the trees alluded to gave rise that, in conversation with parties in Ceylon, I uttered the idea of the possibility of applying the said palm trees, by regular cultivation, as a means of obtaining sugar on the large scale. As, however, my stay in Ceylon was only temporary, and as I, moreover, had neither time nor implements and apparatus for anything like a proper investigation, the matter was left at rest until, after having got settled in the interior of Java, my attention was aroused by the large quantity of sugar which is obtained by the Javanese inhabiting the Preanger Regentschappen from the Aren palm (*Arenga saccharifera*). It is true that the late Professor Reinwardt\* had asserted that the juice of this kind of palm yielded a sweet material, but he had, as was perceived by me at once, erroneously stated that this was simply glucose; for I found that the sugar obtained by the natives in a very rude and primitive manner contains even yet then a large proportion of cane sugar." Dr. de Vry describes the mode of preparation of sugar from the Aren palm, as carried on by the Javanese, as follows:—"As soon as the palm commences blooming, a portion of the stem carrying the blossom is cut away; there exudes from the wound so made a juice containing sugar, which juice is collected in tubes made from bamboo-cane previously exposed to smoke, with the view of preventing the otherwise too rapidly proceeding fermentation of the juice under the joint influence of a warm climate, and the presence in the juice of a nitrogenous substance. The juice so obtained is immediately poured into shallow iron pans, heated by fire and inspissated by evaporation, until a drop of the liquid, exposed to cold by allowing it to fall on a cool surface, becomes solidified; if the desired degree of inspissation has been obtained, as evidenced by this experiment, the whole contents of the pan is cast into the shape of big cylindrical lozenges. Many thousands of pounds of sugar are annually obtained in this very primitive manner. I collected in a clean glass bottle a portion of the juice, and found that the unaltered juice does not contain any glucose at all, but it contains a nitrogenous principle which, aided by the warm climate, soon causes the conversion of a portion of the cane-sugar of the juice into glucose. In order to prove, without the aid of any very artificial means, that the juice of the Aren palm contains pure cane-sugar, I collected a portion of juice exuding from the tree, allowing it directly to flow into alcohol; by these means the nitrogenous principle alluded to is at once eliminated by coagulation. I thus obtained a mixture of equal parts of juice and alcohol; after filtration, this mixture was evaporated on a water-bath to the consistency of a syrup. This syrup I took along with me on my journey from Java home, and during the journey the concentrated syrup became solidi-

\* We shall translate this important memoir in full as soon as we receive it.—ED. C.N.

\* Dr. C. G. Reinwardt, late Professor of Botany and Chemistry of Leyden University, was, from 1816 to 1825 (nifallor), in Java to organise the scientific researches there to be made by botanists, geologists, &c., &c.



fied, exhibiting rare and beautifully well-defined crystals of cane-sugar, which, by every *connoisseur*, were immediately recognised. At the Congress at Giessen I have spoken about the manufacture of sugar from palm trees as the only rational mode of obtaining sugar in future, upon the following grounds:—Sugar, *per se*, consisting, as it does in a pure state, solely of carbon, hydrogen, and oxygen, does not withdraw from the soil anything, but the plants now-a-days mainly cultivated for obtaining sugar therefrom—viz., the *Beta vulgaris* and *Canna indica*—want for their growth a large proportion of substances from the soil in which they are grown for their sustenance; hence their culture impoverishes the soil. This, however, is not the least evil, for what is worse is, that the space now occupied by beet-roots in Europe, and by sugar-cane in the tropics, might and ought to serve for the growing of corn or fodder crops in Europe, and for growing rice under the tropics; and it is my opinion that, owing to the steady increase of population both in Europe and Asia, the time may not be far distant that it will be imperatively necessary to apply the space of ground now devoted to beet-root and sugar-cane to the cultivation of corn-crops and rice, in order to supply the increasing demand for these staple articles of consumption. Whereas sugar-cane and beet-root require such soils as are also adapted for cerealia, the Aren palm flourishes in soils utterly unfit for that purpose, so unfit even that it would be in vain to attempt to render such soils fit for the growing of rice or cerealia; the Aren palm relishes the deep mountain ravines of Java, running, in some parts of the island, from the sea-shore to the interior, the said palm being found in groups together; and it is quite possible to lay out fine plantations of this beautiful tree. There is one drawback, though not a very serious one, viz., not before the trees have obtained an age of from ten to twelve years are they fit to yield sugar. When, however, it yields sugar, the tapping can be continued for many years, and the sugar manufacture will become a continuous—not as now, an interrupted—industry. According to my calculation, a field of 500 square Rynland† roods planted with these trees, would yield annually 40 picols‡ of sugar from a soil quite unfit for any other kind of agricultural service.

"I am, &c.

"Dr. J. E. DE VRY."

## MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Monday, February 6, at 2 o'clock, General Monthly Meeting of Members. Tuesday and Thursday, February 7 and 9, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 10, at 8 o'clock, W. G. Palgrave, Esq., "On Arabia." Saturday, February 11, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

**Artesian Wells.**—It has been observed that Artesian wells can only be successfully bored where porous strata are intercalated between impermeable ones. Where the intercalation is often repeated, several distinct sources of water may supply a single well. In that at Bruck, near Erlangen, there are three such sources; in that at Dieppe, seven; whilst the well at Dulmen, in Westphalia, is supplied by no less than thirteen strata, in a depth of 380 feet. The great distance from which the water of an Artesian well may be derived was well shown by a boring near Tours, from which, when the borer was withdrawn, quantities of sand and small snail-shells were ejected, which must, without doubt, have found their way there from the mountains of Auvergne, thirty miles distant. A curious proof of the occasional direct communication of Artesian borings with superficial accumulations of water

† Equal to about three-quarters of an acre.

‡ One picol is equal to about 60 kilogrammes.

was given by wells of this description at Bochum in Westphalia, and Elbœuf in France, in the water from both of which eels and small fish have at times been found.—*Popular Science Review*.

**Electro-plating.**—In France electro-plating is regulated by law, every manufacturer being required to weigh each article when ready for plating in the presence of a comptroller appointed by the Government, and to report the same article for weighing again when the plating has been done. In this way the comptroller knows to the fraction of a grain the amount of the precious metal that has been added, and puts his mark upon the wares accordingly, so that every purchaser may know at a glance just what he is buying. As to the amount of silver consumed in ordinary plating: An ounce and a-half of silver will give to a surface a foot square a coating as thick as common writing-paper. And since silver is worth 5s. per ounce, the value of the silver covering a foot square would be about 7s. 6d. At this rate, a well-plated tea-pot or coffee-pot is plated at a cost in silver of not more than 7s. to 8s. The other expenses, including labour, would hardly be more than half that amount. Electro-gilding is done in like manner. The gold is dissolved in nitric-hydrochloric acid, washed with boiling nitric acid, and then digested with calcined magnesia. The gold is deposited in the form of an oxide, which, after being washed in boiling nitric acid, is dissolved in cyanide of potassium, in which solution the articles to be plated with gold, after due preparation, are placed. Iron, steel, lead, and some other metals that do not readily receive the gold deposit require to be slightly plated with copper. The positive plate of the battery must be of gold, the other plate of iron or copper. The process is the same as that above described. The popular notion is, that genuine electro-gilding must necessarily add a good deal to the cost of the article plated. This is erroneous. A silver thimble may be handsomely plated, so as to have the appearance of being all gold, for 3d., a pencil case for 10d., and a watch-case for 4s. An estimate of the relative value of electro-gilding, as compared with silver-plating, considering the cost of material alone, is about 15 to 1. The quantity of silver used in plating the ware sent in such large quantities to the colonies is about an ounce to the square mile; one hard cleaning exposes the base metal, and your bargain of plate from auction or that cheap store may be thrown on the dust-heap.—*Technologist*.

## ANSWERS TO CORRESPONDENTS.

\* \* All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements* and *Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

G. C.—Liebig's last letter on the sewage question is a communication to the Corporation of London. It is being printed for circulation among the members of the Corporation, and as soon as it is issued no doubt most of the papers will reprint it. We shall give only a short abstract.

J. J. writes from Newport, Essex, that pigs seem to select coal for food, and that it is common in that part of the country to give them a few.

Received.—Mr. R. F. Smith; shall appear next week.

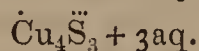
Book Received.—Le Substituant du Condenseur à Surface, &c. Par Emile Martin. Barthes and Lowell.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Preliminary Notes on Brochantite and Atacamite from Cornwall, by A. H. CHURCH, M.A., Professor of Chemistry, R. A. College, Cirencester.*

IN the *Comptes Rendus* of November 28, 1864, M. Pisani gives a brief note on the occurrence of the mineral brochantite in Cornwall. He writes the formula of this species as deduced from his analysis thus,—



This, however, must be a misprint; there should be but one atom of  $\text{SO}_3$ , not three. The author does not give his analytical details, and his numbers do not indicate a very pure specimen. Having obtained, through the kindness of Mr. Richard Talling, of Lostwithiel, who originally detected this species in Cornwall, a supply of this cupric sulphate, I am able to announce that its analysis accords well with those previously published (of specimens from foreign localities), but I am led to propose a slightly modified formula as the best expression of my results. Reserving full analytical and other details for another occasion, I may briefly state that analyses gave the following percentages:—

$\text{Cu}_2\text{O}$	.	.	.	.	69.00
$\text{SO}_3$	.	.	.	.	19.21
$\text{H}_2\text{O}$	.	.	.	.	11.79
					100.00

The formula  $\text{Cu}_2\text{SO}_4 + 5\text{CuH}\text{O}$  demands these proportions:—

$\text{Cu}_2\text{O}$	.	.	.	.	68.98
$\text{SO}_3$	.	.	.	.	19.85
$\text{H}_2\text{O}$	.	.	.	.	11.17
					100.00

The accordance of these experimental and theoretical numbers is all that could be wished; while as to the construction of the new formula proposed, it may be compared, in chemical structure at least, with that of crystallised blue vitriol, as follows:—

Blue vitriol.	$\text{Cu}_2\text{SO}_4 + 5\text{H}_2\text{O}$
Brochantite.	$\text{Cu}_2\text{SO}_4 + 5\text{CuH}\text{O}$

The brochantite often accompanies Professor Maskelyne's new species "Langite," the latter mineral being then seen as a blue crust upon the dark green brochantite. The crystals in my specimens are too imperfect and confused for measurement. The matrix of the brochantite seems to be a decomposing slate, but immediately underlying the cupric mineral crust a considerable quantity of pulverulent ferric oxide occurs. Numerous special experiments have shown me that the Cornish mineral is truly brochantite, and not a new species. It may be added that wadd occasionally accompanies it.

Mr. Talling has also found another copper compound. This latter comes from the district of St. Just, and proves to be atacamite. It occurs in semi-crystalline crusts, in hollow stalactitic tubes, and in a variety of forms more or less distinctly stratified and rippled. The analytical details concerning this mineral are accumulating in my hands, and are nearly ready for publication; I believe I shall thus soon be able to elucidate the true constitution of this species. The proximity of the copper mine in which it is found to the sea, and the detection of sodium and magnesium salts in the atacamite itself, point to the manner of its formation. As may be expected, it is difficult to meet with really pure specimens.

*On Some Aluminium Compounds, by GEORGE BOWDLER BUCKTON, F.R.S., and WILLIAM ODLING, M.B., F.R.S.\**

UNTIL recently the molecule of aluminic chloride had always been represented by the formula  $\text{Al}_2\text{Cl}_3$ , or, selecting the high atomic weight of aluminium, as required by its specific heat,  $\text{AlCl}_3$ . But since Deville's determination of the vapour-densities of aluminic and ferric chlorides, many chemists of eminence, both in this country and abroad, have adopted the formula  $\text{Al}_2\text{Cl}_6$ , and have consistently doubled the previously-received formulæ for the entire series of aluminic compounds. In our opinion, however, the hitherto existing data seemed hardly sufficient for the definitive establishment of either set of formulæ; and it occurred to us that an examination of the so-called organo-compounds of aluminium might not improbably throw some important light upon the question at issue between them. We regarded the determination of the question as a matter of considerable interest from the bearing it would necessarily have upon the position of aluminium in a natural classification of the elements; upon the molecular formulæ of chromic, ferric, cuprous, and perhaps mercurous compounds; and, consequently, upon Laurent and Gerhardt's general law of even numbers. Moreover, a satisfactory investigation of the organo-compounds of a metal certainly not belonging to any one of the recognised classes of metals with whose organo-compounds chemists have become familiar, seemed likely to furnish a useful contribution to the common knowledge of organo-metallic bodies. Cahours, in an admirable paper on the organo-compounds of tin, published early in 1860, observed incidentally that aluminium was attacked by the iodides of methyl and ethyl at the temperatures  $100^\circ$ — $130^\circ$ , and that the crude ethylated product reacted violently with zinc-ethide to form a very inflammable liquid, which was doubtless aluminium ethide. Our experiments in confirmation of Cahours's results have been as yet merely preliminary, but by acting on aluminium with mercuric methide and ethide at the temperature of  $100^\circ$ , we have obtained pure aluminium methide and ethide without difficulty, and in not inconsiderable quantity. This mode of experiment was obviously suggested by Frankland and Duppa's recently described processes for making methide and ethide, and for transforming these compounds into zinc methide and zinc ethide respectively.

**Aluminium Ethide.**—Mercuric ethide with excess of aluminium-clippings contained in sealed tubes was heated for some hours in a water-bath, when the mercury was found completely displaced by the aluminium, thus,— $\text{Al}_2 + 3\text{HgEt}_2 = \text{Hg}_3 + 2\text{AlEt}_3$ , or  $\text{Al}_2\text{Et}_6$ . After distillation off fresh aluminium and rectification in an atmosphere of hydrogen, the resulting aluminium ethide boiled steadily at  $194^\circ$ . It occurred as a colourless mobile liquid, which did not solidify at the temperature of  $-18^\circ\text{C}$ . It evolved dense white fumes on exposure to air, and when in thin layers took fire spontaneously, burning with a bluish red-edged flame, and producing an abundant smoke of alumina. On analysis it yielded 61.4 per cent. of carbon, 12.9 per cent. of hydrogen, and 24.0 per cent. of aluminium—numbers which accord reasonably well with the formula  $\text{AlEt}_3$ , or  $\text{Al}_2\text{Et}_6$ , the carbon and hydrogen being slightly deficient from some unavoidable oxidation of the substance analysed. Its vapour-density, taken by Gay-Lussac's process at the temperature  $234^\circ$ , was found to be 4.5, the theoretical density calculated for the formula  $\text{AlEt}_3$  being 3.9, and

\* Abstract of paper read before the Royal Society.



that for the formula  $\text{Al}_2\text{Et}_6$  being, of course, 7·8. Hence aluminium ethide would appear to have the simple molecular formula  $\text{AlEt}_3$ ; for the difference between the experimental number 4·5 and the theoretical number 3·9, is an obviously necessary consequence of the extreme oxidisability of the compound. Water effected a complete decomposition of aluminium ethide with explosive violence. Iodine reacted upon it, to produce iodo-derivatives and iodide of ethyl. Oxygen in the form of dry air was simply absorbed with production of a body apparently analogous to boric di-oxyethide. But the iodo-derivatives and oxidation products have as yet been submitted to a preliminary examination only.

**Aluminium Methide.**—This compound was obtained by a process strictly analogous to that which yielded us aluminium ethide. On heating mercuric ethide with aluminium clippings in a water-bath, the replacement of the mercury by aluminium took place with even greater facility than manifested during the similar treatment of the ethylated body. After a single distillation, aluminium methide occurred as a colourless mobile liquid, boiling steadily at  $130^\circ$ , and solidifying a few degrees above  $0^\circ$  into a beautiful, transparent, crystalline mass. The liquid took fire spontaneously on exposure to air, burning with a very smoky flame, and producing abundant flocculi of alumina discoloured by soot. On analysis, aluminium methide gave 48·4 per cent. of carbon, 12·3 per cent. of hydrogen, and 38·2 per cent. aluminium, numbers which are quite sufficiently in accordance with the formula  $\text{AlMe}_3$ , or  $\text{Al}_2\text{Me}_6$ . Three separate determinations of vapour density, made at the temperatures of  $240^\circ$ ,  $220^\circ$ , and  $220^\circ$ , the last with hydrogen in the tube, gave the numbers 2·80, 2·80, and 2·81 respectively, which agree closely with the theoretical number calculated for the formula  $\text{AlMe}_3$ —namely, 2·5. But the corrected density increased very rapidly with every decrease of temperature, a peculiarity of behaviour also noticed by Frankland in the case of boric methide. Thus, three separate determinations, made at  $163^\circ$ ,  $160^\circ$ , and  $162^\circ$ , the last with hydrogen in the tube, gave the densities 4·1, 4·1, and 3·9 respectively; while the determinations made at the boiling-point of aluminium methide, of course with hydrogen in the tube, as recommended by Playfair and Wanklyn, gave the densities 4·36 and 4·40 respectively, which approximate somewhat to the theoretical density 5·0, calculated for the formula  $\text{Al}_2\text{Me}_6$ . Hence aluminium methide appears to be a member of that class of bodies whose vapour densities are, under certain circumstances, anomalous, either because the bodies exist in two molecular states of condensation, or because their vapours are not possessed of perfect elasticity until heated considerably above the boiling-points of the respective liquids. In either case the question naturally presents itself—May not the only observed vapour density of aluminic chloride correspond to the high vapour density of aluminium methide; and may they not both be equally anomalous, and consequently untrustworthy as a basis for determining the general formulæ of aluminic compounds?

*The Cyanide from Blast Furnaces,*  
by ROBERT FRAZER SMITH.

It has been long known that alkaline salts containing cyanogen are sometimes discharged from the neighbourhood of the tuyeres of iron furnaces using raw coal and the hot blast. In Percy's Metallurgy it is stated a Mr. Dawes in 1835 inserted in the specification of a patent for improvements in the manufacture of iron a claim for the collection of KCy from iron smelting furnaces

by means of a pipe introduced into the furnace near the tuyeres. Zinken and Bromeis in 1842 published a notice of the occurrence of KCy in an iron smelting furnace at Mägdesprung, giving a qualitative analysis of the substance after it had been exposed to the air four months. Redlenbacher in 1843 published an account of its formation in quantity at an iron-smelting furnace in Styria; he stated it to have all the properties of a mixture of cyanide and cyanate of potassium. Bunsen and Playfair in their celebrated report of the Alfreton experiments, found a large amount of cyanide daily produced in the furnace, but hitherto the presence of soda and lithia in the substance referred to has been overlooked.

One of the Portland iron furnaces near Kilmarnock having for some time produced from leaks in the neighbourhood of the tuyeres large quantities of a saline mass containing cyanogen, samples were frequently procured, and the amount of cyanogen estimated. Some of the specimens were of great beauty, being invariably pure white mottled with pink-coloured veins, probably owing to manganic oxide. One botryoidal mass produced weighed upwards of 50 lbs., and was secured by Mr. Borland, a member of the Pharmaceutical Society, in order to send it to the Pharmaceutical Museum in London, but unfortunately it had been exposed to the too long at the furnace and had become deliquesced. The cyanide not only escaped from the furnace in the fused state, but was present as well in the air within a distance of some feet of it, and could be recognised perfectly well by the odour, and by its settling down in powder on cold surfaces held near the orifice. None of the other furnaces produced it, and the one in question on being blown out and repaired, has also ceased to yield the cyanide, and from inquiries made among the workmen it seems that it is never seen except when a furnace is old and leaky. It occurred to me to test this substance for lithia; accordingly every sample that could be procured was examined with the spectroscope, and in every case the lithium band was seen. On converting the substance into chlorides, and using a mixture of absolute alcohol and anhydrous ether, the chloride of lithium was easily found in comparative quantity. The amount of lithia in three different samples was ascertained by the method of Mayer, recommended by Dr. Miller in his analysis of the Wheal Clifford Spring, and amounted respectively to ·29, ·31, and ·74 per cent. The question arises is the lithia derived from the coal, the limestone, or the ore? I have failed in obtaining any trace of its presence from any of them, but I am still endeavouring to find it in the coal, which has probably been the source of it.

The following is a careful analysis of one of the samples obtained fresh from the orifice, in order to show its composition; all the specimens contained the same ingredients, though varying of course very much in their proportions to each other:—

Cyanate of potassium . . . .	21·45
Carbonate „ . . . .	1·34
Silicate „ . . . .	·98
Sulphate „ . . . .	·41
Cyanide „ . . . .	47·73
Sulphide „ . . . .	1·61
Chloride „ . . . .	·74
Potassa . . . . .	10·13
Soda . . . . .	7·19
Lithia . . . . .	·74
Graphite . . . . .	4·50
Insoluble residue fixed at low red heat.	1·32



The soluble salts did not contain a trace of iron or lime. Ferrocyanogen was likewise absent, but the residue insoluble in water contained silicic acid, lime, alumina, and ferric oxide.

Phosphoric acid was tested for, but no trace of it could be detected with 60 grammes of substance. The graphite was not mere charcoal powder, but possessed all the characteristics of carbon in the graphoidal condition. In six samples the cyanogen varied from 3 to 19 per cent.

Kilmarnock, January 30.

## TECHNICAL CHEMISTRY.

### *Use of Petroleum or Mineral Oil as Steam Fuel in Place of Coal, by B. H. PAUL.*

THIS subject continues to excite so much interest among those connected with steam navigation, and the statements which have been made by those who propose by means of petroleum or coal oil to effect a reorganisation of our naval and mercantile marine are so totally irreconcilable with all known principles relating to the application of fuel, that it will not be superfluous to illustrate this fact by reference to the opinions expressed and to the arguments used by several of the speakers in a recent discussion of the subject at the United Service Institution. Such a course is the more admissible since many who appreciate the importance of any mode of improving or economising the use of fuel confess their inability to judge as to the merits of this project, and express themselves desirous of information.

The data which I have already referred to in this journal,\* for the purpose of showing that the substitution of petroleum for coal as fuel is impracticable, are not disputed. On the contrary, they are adopted by those who advocate this change. But, at the same time, they urge that those data relate only to a theoretical consideration of the subject, and are therefore not to be taken as deciding the practical question as to the relative fuel value of petroleum and of coal. In this opinion I quite concur, but it must be remembered that no means of arriving at a practical solution of this question have yet been afforded. It was only from the want of such positive data, expressing results obtained with petroleum and with coal, as would enable an engineer or any one else to form an opinion as to the comparative values of these materials as fuel for steam vessels, that I was constrained to have recourse to the only accessible criterion by which an opinion could be formed as to the representations which have been made. The comparison of the utmost effects capable of being produced by petroleum and by coal under the most favourable conditions is perfectly valid so far as it applies; but I must admit that it would have been far more satisfactory to have been able to base my opinion on the results of trustworthy experiments made with the object of ascertaining the actual duty obtained with the two materials, and I cannot refrain from expressing my surprise that statements so extraordinary as those I have referred to should have been put forward ostensibly as the result of experiments in the Government dockyard, with the apparent authority they thus acquire, and without a vestige of practical evidence in support of them. Mr. Richardson has publicly declared that forty-two gallons of oil equal one ton of coal in steam-producing power. He admits that this requires proof, and he has promised that it shall

be proved;† but as yet the proof has not been furnished, nor was any approach made towards it in the papers read at the United Service Institution on the 16th inst. It rests, therefore, with the advocates for the use of petroleum to remove the cause of the objection they made to the comparison between that material and coal upon theoretical grounds.

But their chief argument in favour of petroleum is that this material can be used as fuel so that its capability may be rendered effective to a much greater proportion than is possible in the case of coal. Here, again, we are without any evidence of a practical nature in support of this proposition. No doubt it is a well-established fact that different kinds of fuel do not always admit of equal effects being produced in generating steam, although their heating capability or calorific power may be the same. It is upon this ground that the advocates of petroleum take their stand, and Mr. Richardson states that, while one-half of the coal consumed in a marine boiler furnace disappears and is lost as soot and smoke, the heating capability of petroleum is fully utilised.‡ If this were admitted, we should still be far from attaining that advantage from the use of petroleum in place of coal which Mr. Richardson represents by stating that one ton of petroleum equal five tons of coal, for since the calorific power of petroleum is to that of coal as 1.5 : 1, it follows that by fully realising the calorific power of petroleum and realising only half that of coal the practical effects of these materials would be in the ratio of 3 : 1, not as 5 : 1, which upon the same supposition would require the calorific power of petroleum to be 2.5 as compared with that of coal = 1.0. There is therefore some error in this; but without attempting to ascertain in what it consists, it will be more useful to inquire how far there may be—in the absence of those special data which are so much needed—any means of instituting a practical comparison between coal and petroleum in regard to the possibility of using the latter more advantageously than coal as fuel in a marine boiler furnace.

It is well known that no kind of fuel is burnt under ordinary circumstances so as to realise the whole of the heating effect it may be capable of producing. Therefore, the true practical comparison between different kinds of fuel as regards their value consists in ascertaining not only what they respectively can do, but more especially what they really do. The actual work done by fuel depends partly upon its nature, partly also upon the kind of effect to be produced. When an intense degree of heat, or very high temperature is required, as in smelting iron, the heating capability really utilised is not a tithe of that which is utilised when fuel is burnt for generating steam, and still less than that utilised when fuel is burnt in a common domestic grate.

But even in the generation of steam different kinds of fuel give different results, and under the very unfavourable conditions which obtain in a marine-boiler furnace, experience has shown that there is a great difference in the duty or effects produced by equal quantities of different coal possessing equal heating capabilities. Hence the recognised practical superiority of Welsh steam coal over the more bituminous kinds of coal represented by the North country coal.

Now, what is the difference between these two kinds of coal to which their different value as steam fuel is referable? It is simply this, the Welsh coal is almost

† *Mining Journal*, December 24, 1864, page 890.

‡ See *Times*, December 14, 1864, page 7.



entirely fixed, approximating in this respect to pure carbon; it does not give out much combustible gas when heated, but it burns almost entirely within the furnace, and unless the rate of combustion be very rapid, it burns completely, generating its full equivalent of heat, which is transferred through the medium of the combustion products to the water in the boilers. The amount of heat generated by the combustion of the best Welsh coal is equivalent to the production of nearly 15 lbs. of steam from water at  $212^{\circ}\text{F}$ . for each pound of the coal completely burnt. Of course this duty is never realised in practice, because the water has to be heated to the boiling point, and because the whole of the heat generated cannot be transferred to the water in the boiler, great part of it escaping in the combustion products. But the approximation to that theoretical duty will be greater in proportion to the perfect combustion of the coal, and to the absence of soot or smoke production. For every pound of soot or smoke produced, the possibility of generating at least seven pounds of steam will be lost, and the duty of the coal will be proportionately reduced.

The calorific power of the best bituminous coal is not appreciably less than that of Welsh steam coal, but it contains from 30 to 40 per cent. of volatilisable substance, and consequently when heated combustible gas or vapour is evolved to that extent. This gas or vapour, amounting to something like 300 times the volume of the coal from which it is produced, mixes with the combustion products, and is thereby rendered less readily combustible. Under the influence of the draught, and by reason of its great bulk and mobility, it is drawn out of the furnace before it can be burnt, and passing into the tubes of the boiler the combustion is stopped partly by the cooling of the gas, and partly by the want of air, so that instead of generating its equivalent of heat, it produces soot and smoke.

This action takes place to some extent with all coals, especially when it is burnt under the unfavourable conditions obtaining in a marine-boiler furnace, and it was the disregard of this circumstance which vitiated the results of the long and costly experiments made some years ago by Dr. Lyon Playfair, with the view of ascertaining the relative value of different kinds of coal as fuel. But in regard to steam navigation the relative values of different coals are determined by the degree to which this action takes place. The more a coal is capable of being burnt within the furnace, the better it is for that purpose. The greater the amount of volatilisable substance it contains, the less suitable it is, and the greater the extent to which production of soot and smoke is substituted for the production of heat. These being correlative results, it follows that the fitness of coal for steam navigation is inversely proportionate to the amount of volatilisable substance it contains. It is for this reason that while the duty obtained with Welsh coal sometimes exceeds 10 lbs. of steam per pound of coal burnt, that obtained with Newcastle coal is often as low as 6 or 7 lbs.

Applying this result of long experience to the case of petroleum as compared with coal, the conclusion to which it leads is even more disadvantageous for the former than the comparison already made on the ground of calorific power and cost. § For petroleum is altogether volatilisable, and is, consequently, peculiarly liable to produce soot and smoke when burnt even slowly, and without any of those disadvantages to which it would be subject in the furnace of a marine-boiler.

Indeed, it appears to me that nothing can be more incompatible with the use of petroleum as fuel than the conditions which obtain in that case. No doubt it may be urged in answer to this that the introduction of a peculiar boiler is contemplated; but nothing need be said as to that contingency until the superiority of petroleum over coal shall have been satisfactorily made out.

The objection I have urged to the use of petroleum on the score of cost has been answered by Captain Selwyn, who suggests that the price of petroleum ought to be reduced if it came to be used as fuel, and that if it were not he believes a material almost identical with it may be obtained from coal at a lower cost—9 $\frac{1}{2}$  or 10 $\frac{1}{2}$  per ton. So far as the price of petroleum is concerned, I am disposed to consider any anticipation of a reduction as being extremely delusive, and the lower cost of coal oil would still leave it at a great disadvantage as compared with coal.

But if Captain Selwyn, before assuming the part of a protecting ægis to a deluded inventor, had applied to his own conceptions that simple axiom that "a whole is greater than its part," he would probably have seen a little more clearly the value of the whole project of re-organisation which it is proposed to carry out in relation to steam navigation. Thus, for instance, the very richest oil-yielding coal known—the Leeswood cannel—yields about one-third its weight of oil. In producing a ton of oil from three tons of this coal, a considerable quantity of combustible gas, capable of generating a large quantity of heat, is lost, and there remains greater part of the carbon of the coal in the state of coke, amounting to more than one ton. Both the gas and the coke are of value as fuel, so that the real fuel-value of the oil from three tons of coal is, in fact, equal to the total fuel-value of that quantity of coal *minus* the fuel-value of the coke and gas. But according to the representations made in favour of substituting coal-oil for coal as fuel, one ton of oil is to do the work of five tons of coal; so that, according to this view, the fraction of the heating power belonging to the three tons of coal will be equal to the heating power of five tons of coal!! This is equivalent to the proposition that part of three is equal to five, an absurdity so glaring that it is truly wonderful that it should have escaped recognition even by an inventor.

The signal misconception which characterises the views of those who advocate the substitution of petroleum for coal in steam navigation was illustrated in an almost equal degree during the discussion following the papers read by Captain Selwyn and Mr. Richardson at the United Service Institution. Thus, for example, Sir Edward Belcher referred to the oxyhydrogen flames as proving the fuel-value of hydrogen to be much greater than that of carbon or of coal. Nothing could possibly be more irrelevant, and it can only be inferred that Sir Edward Belcher is not aware that the thermal efficacy of the oxyhydrogen flame is solely due to the fact that oxygen gas is used in the place of air for the combustion. This circumstance alone places the oxyhydrogen flame beyond the range of a practical consideration of the subject; but so far as a comparison can be instituted between hydrogen and carbon when burnt with oxygen, the fact is that the thermal effect or temperature produced by carbon under that condition is far greater than that produced by an equal weight of hydrogen; these effects being in the ratio of about 10 : 7. When those substances are burnt in air, the difference in thermal effect is inappreciable. So far as the possible evaporative effect is concerned, the difference between petroleum and coal, in

§ See CHEMICAL NEWS, December 17, 1864, page 292.



the amount of hydrogen they contain, is not so great as to have a very great influence; and since an increase in the amount of hydrogen in fuel is accompanied by increased liability to produce smoke and soot, it would, under existing circumstances, be rather a disadvantage than otherwise. Captain Selwyn's reference to the common fishtail gas burner used for illuminating purposes, and to the Bunsen burner used in laboratories for heatings, as being illustrative of the different effects obtainable by burning combustible substances under different conditions, was equally infelicitous, and indicated an equal ignorance of the most rudimentary principles affecting the use of fuel; for in the flame of the fishtail burner and in that of the Bunsen burner the heating effects produced are equal for equal quantities of gas burnt, and the thermal effects or temperatures produced are probably little, if at all, different. Both these gentlemen appear to be very much "at sea" in their notions respecting fuel and its applications.

The view of this subject which is put forward in the above remarks will doubtless appear to many extremely trite and self-evident; but the fact that it is not so to every one interested in the use of fuel may perhaps be a sufficient excuse for stating it so fully, and the still more remarkable fact that some who have held such a view have been induced to abandon it, and to express themselves satisfied with the astonishing statements made as to the effects of petroleum when used as fuel, will show what strange results may be produced by vigorous assertion even of the most palpable absurdities. In fact, the whole of the arguments brought forward by those who contemplate effecting the entire reorganisation of our navy, and of steam navigation, indicate a woeful deficiency of acquaintance with the subject, and well illustrate the proverbial danger of a "little knowledge."

There is, however, still room to hope that, by having recourse to that practical mode of deciding any question there may be in their minds as to the relative values of coal and petroleum, which I fully agree with them in thinking the only satisfactory test, and which is unfortunately a great desideratum in the present case, they will arrive at such a state of disillusion as will permit them to make a more useful application of their ingenuity.

#### *On Aniline Black,\* by M. LAUTH.*

ANILINE black is a new coloured derivative of aniline, which, so to say, completes the series of brilliant colours derived from this base. It differs, however, in many respects from the other coloured derivatives. The mode of production, the way of fixing it on fabrics, and the insensibility to physical and chemical agents which it presents, are points on which it differs essentially from the red, blue, and violet of aniline.

Mr. Lightfoot's process, which the author quotes, is well known to our readers, and we shall only quote from this paper the author's new process for aniline black, which, it will be seen, and, indeed, is admitted to be, but a simple modification of Mr. Lightfoot's.

M. Lauth's process consists in printing with the mixture of hydrochlorate of aniline and chlorate of potassium an insoluble oxidisable salt, which will become soluble on the fabric—sulphide of copper, for example.

By the oxidising action of the chloric acid (or the chlorine which is set free by the reaction of hydrochlorate of aniline on chlorate of potassium), the sulphide of copper is transformed into sulphate.

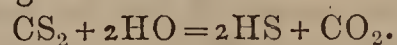
In this same process some of the disadvantages of Mr. Lightfoot's process are avoided. It is a more economical, the mixture does not act on the steel rollers, nor does it weaken the fabric—not more, at all events, than madder black. The colour is very permanent, and is fixed at from 20° to 40° C. Its composition allows of its being printed with all sorts of colours.

Aniline black has a specially beautiful appearance; it has a very rich black velvety look. It is completely insoluble in water, alkaline or acid, and is not affected by soap. Acids change the black to green, but the original colour is restored by an alkali. Bichromate of potash deepens the shade, but a very strong solution slightly reddens it. Strong chloride of lime bleaches it, but the colour returns after a time.

M. Lauth promises another and further account of aniline black in a short time.

#### *Removal of Bisulphide of Carbon from Gas.*

MR. LEWIS THOMPSON has published† a very simple process for purifying gas from bisulphide of carbon. It is based on the fact that the bisulphide and the vapour of water cannot exist together at a red heat, mutual decomposition taking place with the formation of sulphuretted hydrogen and carbonic acid.



The removal is carried out practically by mixing the gas as soon as it leaves the hydraulic main with a certain proportion of steam, and carrying the mixture through a tube heated to a fully cherry red. The length of this tube must be proportioned to the velocity of the current, so that there may be time for the whole of the mixture to become heated. The products of the reaction are, of course, removed by the ordinary methods of purification. Gas from ordinary coal so treated does not, according to Mr. Thompson, have its illuminating power diminished by the treatment.

### PHYSICAL SCIENCE.

#### *On the Invisible Radiation of the Electric Light,* by JOHN TYNDALL, F.R.S.‡

PENDING the preparation of my complete memoir, which may occupy me for some time to come, I would ask permission of the Royal Society to lay before the fellows a brief and partial summary of the results of my experiments on the invisible radiation of the electric light.

The distribution of heat in the spectrum of the electric light was examined by means of the linear thermoelectric pile, applied to the solar spectrum by Melloni, Franz, Müller, and others. The electric spectrum was formed by lenses and prisms of pure rock-salt, its width being equal to the length of the row of elements forming the pile. The latter, standing at right angles to the length of the spectrum, was caused to pass through its various colours in succession, and to search the spaces beyond the region of colour in both directions.

As in the case of the solar spectrum, the heat was found to augment from the violet to the red, while the maximum heating effect was observed beyond the red, and at a distance from the red, in one direction, equal to that of the green of the spectrum in the other.

The augmentation of temperature beyond the red in

† Newton's *London Journal of Arts*, February, 1865.

‡ Abstract of paper read before the Royal Society.

\* Abridged from the *Moniteur Scientifique*, January 15, 1865.



the case of the electric light is sudden and enormous. Plotting from a datum line the thermal intensity of the various portions of the spectrum, the ordinates suddenly increase in length beyond the red, reach a maximum, and then fall somewhat more suddenly on the other side. When the ends of the ordinates are united, the curve beyond the red rises in a steep and massive peak, which quite dwarfs the luminous portion of the spectrum.

The comparative height and steepness of this peak are much greater than those obtained by Professor Müller for the solar spectrum. Aqueous vapour acts powerfully upon the invisible rays, and, doubtless, the action of this substance in our atmosphere has toned down the eminence beyond the red in Professor Müller's diagram. A solar spectrum, produced beyond the limits of the atmosphere, would probably exhibit as steep a peak as that of the electric light.

In the experiments now to be referred to, the rays from the electric light were converged by a small concave mirror. The glass mirror silvered at the back, which usually accompanies the camera of Duboscq's electric lamp, was one of the first employed. It was brought so near the electric light as to cast an image of the coal-points five or six inches in advance of the light. A solution of iodine in bisulphide of carbon, contained in a rock-salt cell, was then placed in front of the lamp: the light was thereby cut off, but the focus of dark rays remained, and various effects of combustion and incandescence were obtained at the focus. A mirror four inches in diameter, and silvered in front, will enable an experimenter to obtain most, if not all the results now to be mentioned. I also employ a mirror eight inches in diameter, and having a focal length of eight inches, with excellent effect.

It is not necessary to enclose the opaque solution in a rock-salt cell. The vessel intended for a solution of alum, which usually accompanies the lamp of Duboscq, and the sides of which are of glass, answers admirably. It is not, however, quite deep enough for the several tests to which I have subjected it, and in crucial experiments I employ a deeper vessel with rock-salt sides.

With the eight-inch mirror just referred to behind the electric light, the opaque solution in front, and the focus of invisible rays about six inches distant from the electric light, the following effects have been obtained:

1. Wood, painted black, when brought into the dark focus emits copious volumes of smoke, and is soon kindled at the two spots on which the images of the two coal-points fall.
2. A piece of brown paper placed near the focus soon shows a burning surface, which spreads over a considerable space, the paper finally bursting into flame.
3. Black paper brought into the focus is immediately inflamed.
4. The wood of a hat-box similarly placed is rapidly burnt through, and usually bursts into flame.
5. The end of a cigar, placed at the dark focus, is instantly ignited.
6. Disks of charred paper placed in the focus are raised to brilliant incandescence, surfaces of considerable extent being brought to a vivid glow. Charcoal is also ignited.
7. A piece of charcoal, suspended in a receiver of oxygen, is ignited in the dark focus and caused to burn brilliantly, the rays after crossing the glass of the receiver being still sufficiently powerful to heat the coal up to incandescence.
8. A mixture of oxygen and hydrogen is exploded in the dark focus by the ignition of its envelope.

9. A piece of zinc-foil, blackened on one side to diminish reflection, is pierced and inflamed. By gradually drawing the strip, once inflamed, across the focus, it may be kept blazing for a considerable length of time. This is a particularly beautiful experiment.

10. Magnesium wire, presented suitably to the focus, burns with its intensely luminous flame.

In all these cases the effect was due, in part, to chemical action; this, however, may be excluded.

11. A plate of any refractory metal, sufficiently thin, and with its reflective power suitably diminished, is raised to incandescence in the dark focus. Gold, silver, copper, aluminium, and platinum have been thus rendered incandescent.

12. Platinised platinum shows the effect best; in a thin leaf it may be rendered white-hot, and on it is depicted an incandescent image of the coal points. When the points are drawn apart, or caused to approach each other, their incandescent images conform to their motion.

The assemblage of phenomena here described, and others to be referred to in my completed memoirs, may, I think, be properly expressed by the term "calorescence." This word involves no hypothesis, and it harmonises well with the term fluorescence, now universally employed with reference to the more refrangible end of the spectrum. §

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, February 2.

On this occasion the meeting was held, by the special invitation of the Council, in the lecture theatre of the Royal College of Chemistry. There was a very large attendance of members, and Professor A. W. Williamson, Ph.D., F.R.S., President, occupied the chair.

The proceedings were commenced by reading the minutes and balloting for the election of the following gentlemen, viz.—Mr. Charles Eastcourt, Manchester; Mr. Arthur Vacher, 29, Parliament Street, London; Mr. Francis Walker, Sidney College, Cambridge; Mr. John Reid, Trinity College, Cambridge; Mr. Thomas P. Blunt, B.A., Shrewsbury; Mr. Robert H. M. Bosanquet, Oxford; Mr. Nathaniel Bradley, Prescott, Lancashire; Mr. Richard Percival, University of Glasgow; Mr. Arthur Smith, Loughborough Road, Brixton; and Mr. Thomas Heathcote Windham. These several candidates were declared to be duly elected Fellows of the Society.

The PRESIDENT then called upon Professor Hofmann to favour the Society with an account of the *Lecture Illustrations* which he had apparently taken so much trouble to prepare for them on this occasion.

Dr. Hofmann said the present aspect of chemical science might be fitly compared with a field of battle immediately after a decisive engagement, when the vanquished squadrons, for a time dispersed, were again rallying for a renewed attack. The picture of confusion which supervened was suggestive of the state of difficulty and doubt

§ On December 5 last I tried the passage of the rays from the electric lamp through a great number of different coloured glasses. Incandescence was obtained through almost all of them; and in one instance, the radiation passing through a blue glass, the thermograph of the coal points was of a pink colour. A thick black glass, obtained from Mr. Ludd, when held in front of the lamp, was found to be not perfectly opaque, still the platinum could not be raised to incandescence at all when placed in the focus. Being called away from the Royal Institution early in the afternoon, I gave directions to my assistant, Mr. Barrett, to continue the experiments. He informs me that on placing in the path of the rays a combination of two thin plates of black glass, one transmitting a whitish-green and the other a deep red, the light was entirely intercepted and feeble, though distinct incandescence was obtained at the focus. With radiation through the solution of iodine, the thermograph on this day rose to a white heat.



which necessarily accompanied a great revolution, and before the new rule in chemistry was generally acknowledged, there must be a period of perplexity, both to the student and professor. In his intercourse with students such phrases of explanation or inquiry as "old style," "new style," "newest style," "little or big equivalents," &c., were of common occurrence; but although these disputed points might for a time give rise to some little inconvenience in the ordinary teaching of the science, they were but trifling difficulties in the way of the glorious consummation of the revolution which he trusted was near at hand. For the new theory, the speaker claimed advantages on the score of greater simplicity and precision; at the same time, it was more practically useful and suggestive. There could be no doubt that it was increasing in favour, and many of his friends now present had already adopted it. He hoped that Dr. Odling, who had already done much to help the cause, would shortly find leisure to complete his treatise which bids fair to become the text book of the science under its new aspect. Dr. Miller also had taken up the question with extraordinary vigour, and the capital work of Mr. Watts was worthy of particular mention. Still much remained to be done before the newly-acquired views could be elaborated into a methodical system of teaching chemistry. It could not be denied that we had to break with many of the classical traditions of chemical instruction. He did not allude to the necessity of acquiring the habit of calling water  $H_2O$ , instead of  $HO$ , or marsh gas  $CH_4$  instead of  $CH_2$ , but to the radical change which had to be introduced into the general system of teaching, to the choice of subjects prominently to be brought forward, and more especially to the form and style of illustration adapted to the elucidation of these subjects. The Chemical Society includes among its members many professors of chemistry, and the speaker desired to promote an interchange of experience among his colleagues; in fact, the present statements had emanated more particularly from a conversation with Dr. Miller upon the best means of illustrating particular facts, which were no doubt capable of demonstration, but had usually been taken for granted in their course of lectures.

It was one of the delightful prerogatives of chemical teachers that they were enabled to survey their subject from a great variety of points of view, but whatever plan might be adopted in future teaching, he could scarcely doubt that far greater prominence would be given to those four typical hydrogen compounds, hydrochloric acid, water, ammonia, and marsh gas, which might be called the four corner stones of the modern structure of chemistry. For three or four years past he had been in the habit of inaugurating his annual course with a series of eight or ten lectures on these typical bodies.

In attempting the experimental demonstration of the composition of these bodies the lecturer said he had met with certain difficulties; some of these failures he thought should be recorded, so as to avoid loss of time on the part of others working in the same direction, thus in the electrolysis of hydrochloric acid performed in the ordinary manner, but under a great variety of circumstances, he found it practically impossible to obtain equal volumes of hydrogen and chlorine, and if the gases were evolved under pressure, the apparatus being surrounded with hot water so as to diminish the solubility of the last-named gas, the platinum poles were very quickly dissolved. The synthesis of hydrochloric acid from given volumes of chlorine and hydrogen was next attempted in the following manner:—A glass tube, both extremities of which could be closed by small glass stopcocks, was filled with dry chlorine gas, and then placed in communication with a U-tube containing an equal volume of dry hydrogen confined by means of a column of mercury; then, the stopcocks being opened, the electric discharge from a Ruhmkorff coil was passed across the point of junction

of the two tubes, and a series of small explosions occurred; but never was the combination perfectly effected, small quantities of the hydrogen and chlorine refused to combine, and the final product was not therefore perfectly absorbed by water when the tube was removed and afterwards opened under the liquid. In the French, and also in some of the German, manuals of chemistry was to be found a very nice woodcut illustrating an arrangement of apparatus for showing the decomposition of hydrochloric acid gas by means of a pellet of potassium or sodium in a bent glass tube standing over a mercurial trough. His friends would recognise, in the sketch on the board, the "*cloche courbe*" of the French chemists; but could any one inform him how a potassium pellet free from oxide was to be got through the mercury into the tube? On making the same inquiry of a celebrated French professor, he replied—"C'est une des expériences qu'on ne fait pas." The lecturer then proceeded to show an experiment whereby the composition of hydrochloric acid was easily demonstrated. A glass U-tube, having one extremity perfectly closed and the other provided with a stopper, was filled nearly to the bend with dry hydrochloric gas over mercury; the volume was accurately registered by an india-rubber ring after the level of the mercury had been equalised in both limbs of the tube, the excess of metal being allowed to flow out at a supplementary aperture placed near the bend. This aperture having been again closed by a pinch-cock, a long funnel was introduced and the remaining space of the open limb filled with a quantity of freshly-made sodium amalgam, the stopper was firmly adjusted, and the gas transferred to this limb of the tube and made to pass several times through the sodium amalgam. When the absorption of chlorine was judged to be completely effected, the remaining gas, hydrogen, was returned to the original position and measured, after equalisation of the mercury level, as before. The constituent was now found to occupy exactly half the volume of the hydrochloric acid experimented upon; the difficulty with the *cloche courbe* was thus overcome. It was requisite to prove, in the next place, that one volume of chlorine was united with one volume of hydrogen without condensation; this could easily be done by making use of a modified electrolytic apparatus, whereby, with two cells of Bunsen's battery, the mixed gases evolved from a small bulk of liquid hydrochloric acid were collected in long glass tubes, which were then sealed at the ends. If the extremity of one of these tubes was broken off whilst immersed in an outer cylinder of water coloured by logwood, the liquid entered, a bleaching action was apparent, and the tube filled to the extent of one-half. Lastly, by breaking off the upper extremity and depressing the tube, the hydrogen rushed out and could be inflamed. Dr. Hofmann stated that he kept always on hand a number of such tubes filled with hydrogen and chlorine; they might be preserved for any length of time in blackened tin cases. The lecturer then exhibited the mode of inducing the combination of the mixed gases by exposing one of the tubes to the blue flame of bisulphide of carbon burning in nitric oxide. The ends were for this experiment strengthened by external glass tubes cemented on with sealing-wax. After the combination had been effected, the volume of gas remained constant, which was shown by opening under mercury; the tube was then transferred to the deep cylinder of coloured water as before, and very quickly became entirely filled with the liquid. Thus it had been perfectly demonstrated that "two volumes of the constituents produced two volumes of the compound."

Passing now to the history of water, the lecturer showed a new apparatus for the electrolysis of this liquid which permitted of the collection of the gases separately, of noting their comparative volumes, and afterwards of identifying the gaseous constituents by a lighted match. It simply consisted of a long U tube, the shorter limb of



which was subdivided into a fork, wherein the oxygen and hydrogen were to be collected separately, the gases being disengaged from platinum wires sealed within the tubes and externally connected with the battery; the upper extremities of the tubes were closed by glass stop-cocks, for the purpose of facilitating the examination of the gases. During the disengagement of the hydrogen and oxygen, a considerable column of liquid had risen in the tall limb, so that the two gases were under moderate pressure. Upon opening the stop-cock of the tube containing oxygen, a jet of the gas issued forth and rekindled a glowing match, which then was held over the hydrogen jet, and this gas allowed to become inflamed. Dr. Hofmann then showed a lecture experiment which demonstrated the fact that two volumes of hydrogen and one volume of oxygen become condensed to two volumes of aqueous vapour in the act of combination. A bulk of the mixed gases was confined in the closed limb of a U-tube, similar to the one used in the analysis of hydrochloric acid, over mercury, and then surrounded by an outer tube through which the vapour of boiling amyl alcohol (about  $130^{\circ}\text{C}.$ ) was constantly passing. The gas was then accurately measured; the electric spark having been transmitted, an explosion ensued, and the resulting compound occupied but two-thirds of the original volume of its gaseous constituents.

With respect to the constitution of ammonia, the lecturer first showed that by passing the discharge from a Ruhmkorff coil through ammonia gas confined in a U-tube by a column of mercury, the compound became resolved into a mixture of its gaseous constituents which then occupied a double volume. The crowning experiment was, however, that which demonstrated the proportion of nitrogen existing in ammonia. A long tube, having its linear dimension divided into three equal parts by india-rubber rings, was filled with chlorine over the pneumatic trough, and to its open extremity was quickly adapted a small glass globe, containing strong ammonia. On opening the stop-cock, a few drops of liquid entered, which immediately gave rise to a brilliant flash of light; then more ammonia was introduced, and the liquid slightly warmed, to complete the decomposition and ensure the destruction of any trace of chloride of nitrogen. The ammonia remaining in the little globe was then exchanged for dilute sulphuric acid, and a bent tube, dipping into a larger quantity of the same liquid, was placed in communication. The stop-cock being again opened, the fluid entered and quickly occupied exactly two-thirds of the tube, leaving one-third of pure nitrogen. Knowing already that chlorine induces the absorption of a volume of hydrogen equal to itself, it had thus been demonstrated that hydrogen unites with nitrogen in the proportion of three to one when forming ammonia. Dr. Hofmann said that his experiments with marsh gas—the last of the series of typical compounds—had not been attended with equal success; and he ventured now to appeal to his colleagues for their advice and suggestions. Marsh gas doubled its volume under the influence of the electric spark; but the results were slightly erratic. The disposition of the carbon to form a bridge of communication between the poles could be overcome by occasionally reversing the direction of the current. At present, however, the lecturer was not prepared to show any good analytical proof of the composition of marsh gas.

The lecturer was ably assisted in the experiments by Mr. McLeod, and the whole subject appeared to possess great interest for the audience.

The PRESIDENT said that, owing to the lateness of the hour, he could scarcely invite them to discuss the experiments which had been brought under their notice; but moved a vote of thanks to Dr. Hofmann, which was warmly responded to, and commented upon the importance of placing before the student certain leading experiments, such as those they had just witnessed, by which the con-

stitution by volume of a number of typical compounds was made manifest to them at the commencement of a course of lectures.

The titles of several papers were announced, and the meeting was then adjourned until the 16th instant.

## PHARMACEUTICAL MEETING.

Wednesday, February 1.

Mr. HILLS, Vice-President, in the Chair.

THE first paper read was "*On the Kola-nut of Tropical West Africa*" (the Guree-nut of Soudan), by Dr. W. F. Daniell, F.L.S. The seeds of the cola tree (*cola acuminata* R. Br.), said the author, have been from time immemorial an important article of commerce among the natives of Central and Western Africa, and are to be found also in the markets of Fez, Tripoli, and other mercantile depôts on the Mediterranean. The Portuguese merchants have always accepted the statement of the natives that the nuts are a luxury reserved for the chiefs and richer classes of natives, and are merely used as a means of rendering water pure and palatable; and thus never dreamt of the seeds containing a highly nitrogenised body. But the circumstance that all who can procure the nuts indulge in chewing them all day long, might have suggested that they contained something of much value, if not of actual necessity, in a country where animal food is scarce, and often difficult to procure. Dr. Daniell then proceeded to give an interesting account of the uses of the seed in aboriginal customs. It seems that when a trader visits a chief, the present of a few seeds from the latter conveys an assurance of welcome and protection. When sent as a present by one chief to another at a distance, the seeds are received as a sign of friendship, and the compliment is always reciprocated. In parts of the country where the kola tree is not indigenous, no business can be done with the higher classes without the gift of some of the nuts. Wives also are purchased with kola seeds; and the fetish man who raises the dead completes his charms with the offering of some of the seeds the deceased loved so much when alive. They are used, too, as propitiatory offerings to malignant spirits, and with peculiar customs to decide the question of peace or war between distant tribes. They are highly appreciated, too, as a gift on the departure of a guest for a long journey, in the course of which they are found of the greatest value in supporting strength and allaying hunger. The Portuguese, Dutch, and English residents in Western Africa have adopted the use of the seeds, and now they seem to have become a necessity. They are not eaten at meals, but are carried in the hand, and fragments are chewed at intervals, the pulp being spat out, and the soluble part only swallowed. The seeds have been supposed to possess the qualities of Peruvian bark; but the most prominent physiological effect of their use is insomnia, or want of sleep, and on this account they are used by the natives to prolong their orgies. The Portuguese have made a yellow dye from the seeds. With regard to the name, it would seem that the seeds were originally called "Goro," or "Guro;" but the tribes of Western Africa, from a physical defect, are unable to pronounce the letter "r," for which they substitute "l," and among them the nuts are called "Kola," or "Gola," a name which has been adopted by the Portuguese. Dr. Daniell then gave extracts from the earlier African travellers, which showed that they had heard or become acquainted with the use and properties of the Kola seeds. Lastly, he stated that when on the Gold Coast in 1850 he suffered from a severe diarrhoea, for which the inhabitants were in the habit of employing a decoction of fresh seeds. He tried the remedy, and found that it deprived him of sleep. This led him to suspect the presence of theine in the seeds, and, when in Jamaica some years afterwards, he made some experiments to determine the presence, if



possible, of this alkaloid. He did, in fact, obtain some crystals, which later researches have decided to be theine.

The reading of this paper was followed by a verbal account, by Dr. Attfeld, of the results of his analysis of the seeds. A report of this, and also of a paper by Mr. Hanbury, "*On the Botanical Origin of Savanilla Rhatany*," we postpone until our next.

As the next Pharmaceutical Meeting will take place on the 1st of March, the day on which the *Pharmaceutical Journal* reaches the members, we may announce at once that at that meeting Dr. Redwood will read a paper, "*On the Preparation of Nitrous Ether and Sweet Spirit of Nitre*."

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 10, 1865.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

DR. ROSCOE exhibited some very interesting photographs of the fixed lines in the solar spectrum made by Mr. Rutherford, of New York. These photographs exhibit groups of thousands of lines extending from near the line *b* in the green to beyond *H* in the violet, and serve as a most valuable confirmation of the accuracy of Kirchhoff's maps. Each line in these maps can be easily and distinctly traced in the photograph, whilst many bands drawn as single ones by Kirchhoff are seen in the magnified photograph to consist of bundles of fine lines. These photographs were prepared with three 60° bisulphide of carbon prisms.

Dr. Roscoe also exhibited two fine photographic prints of the moon, enlarged by Mr. Rutherford from negatives taken by him in New York with an 11½ inch object-glass of 14 feet focal length, which he had ground with special reference to the highly refrangible rays, and which is therefore unfit for ordinary telescopic purposes.

Mr. BAXENDELL and Mr. WILKINSON, F.R.A.S., expressed their opinion that Mr. Rutherford's prints were decidedly sharper than any photographs of the moon they had seen.

A paper, by Dr. E. SCHUNCK, F.R.S., Vice-President, was read "*On Some Products Derived from Indigo Blue*." By his experiments on the formation of indigo blue, an account of which was laid before the Society several years ago, the author was led to make some inquiries regarding the processes employed in tropical countries for the production of indigo from plants. All authorities, it appears, agree that the process of fermentation, which is the one usually adopted for the purpose of extracting the colour, requires to be conducted with the greatest care in order to lead to a successful result. Unless certain precautions are adopted the colouring matter may be entirely lost. This phenomenon may be easily accounted for. Though indigo blue, when once formed, is a very stable body, the substance existing in the cells of the plant from which it originates, and which the author terms *Indican*, is decomposed with the greatest facility, indigo blue being only one of its products of decomposition, which may be formed or not, according to the nature of the process employed. There are, however, other facts connected with this subject which cannot so easily be explained. It is well known to those dyers who employ the so-called *woad vat*, in which the reduction of the indigo blue is effected by means of various organic matters, such as woad, madder, and bran, together with lime, that if the process be not carefully managed it may change its character entirely—a change which results in the total destruction or disappearance of the colouring matter. This phenomenon cannot be explained in accordance with what is at present known regarding indigo blue, which is considered by chemists to be a body of such a stable character as not to be decomposed by any except very potent agents,

such as chlorine, bromine, or nitric acid. It has not hitherto been supposed possible to effect its decomposition by means of fermentation or putrefaction. Then, again, the author found that when very small quantities of indigo blue are reduced according to Fritzsche's method, which consists in acting on it with alcohol, grape sugar, and caustic soda, the colouring matter does not make its appearance again when the solution is exposed to the atmosphere. The liquid yields no deposit and remains yellow and transparent. This fact is also difficult to account for, since it is usually supposed that by the combined action of reducing agents and alkalies indigo blue merely takes up an atom of hydrogen and then dissolves, and by the action of oxygen is again precipitated unchanged and undiminished in quantity. By the continued action of a large excess of alcohol and grape sugar, together with caustic soda, the author succeeded in causing several grammes of indigo blue to disappear entirely. That the effect was due to the combined action of alcohol and grape sugar, not to that of one or the other only, was proved by subjecting a small quantity of indigo blue to the action of grape sugar and caustic alkali in watery solution, and another portion to the action of alcohol, protoxide of tin, and alkali. Reduction of course took place in both cases; but, though the solutions were boiled for some time, the colouring matter was in each case precipitated again on exposure to the air, apparently undiminished in quantity. Since, by the action of caustic alkalies on grape sugar, acetic and formic acids are formed, it occurred to the author that the effect produced by the sugar in this process might in reality be due to the presence of one or both of these acids rather than to the sugar itself. This supposition was completely verified by experiment. The colouring matter disappeared quite as rapidly when acetate or formiate of soda was employed in the place of grape sugar. The use of the latter was therefore abandoned in the subsequent experiments. In the present communication the author confines himself to an account of the combined action of alcohol, acetate of soda, and caustic soda on indigo blue. The process adopted was quite simple. Pure indigo blue was introduced into a large quantity of ordinary spirits of wine, and, after being well agitated, the mixture was raised to the boiling-point. A quantity of pure acetate of soda, previously deprived of its water of crystallisation, and a little caustic soda were then added, and the boiling was continued for several hours. A reduction of the indigo blue took place in the first instance, as was evident from the deep red colour of the liquid. On agitating with air this red colour disappeared for a moment, the indigo blue being precipitated in powder, but after some time the liquid acquired a dark brown colour and deposited nothing on exposure or agitation. The process was then completed. In order to obtain the products formed, the brown liquid was evaporated, and, when the evaporation was nearly completed, water and an excess of sulphuric acid were added, which threw down a brown insoluble mass, consisting partly of resinous, partly of pulverulent substances. From the liquid, which was of a light brown colour, a crystallised acid was obtained, which after being purified was found to consist of anthranilic acid. From the mass, insoluble in water, the author obtained five distinct substances, which were separated from one another by means of various solvents, such as alcohol, ether, ammonia, and carbonate of ammonia. These substances were all brown and amorphous. Some of them resembled resins, others were powders. In general they were found to possess very few characteristic properties, and as they presented very little that could be of interest to the chemist, if their origin and their mode of formation be excepted, the author refrained from bestowing names on them, and thus adding to the already unwieldy mass of terms with which chemical science has to deal, but preferred to distinguish them by the letters of the alphabet, as A, B, C, D, and E. The body A is easily



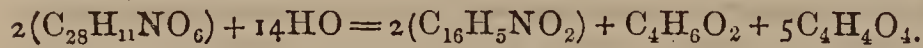
soluble in cold alcohol and ether, but quite insoluble in alkalies. B is easily soluble in alcohol and ether, as well as in alkalies, both caustic and carbonated. These two have the appearance of resins of a rich brownish-yellow colour. C is very little soluble in alcohol and ether, and insoluble in alkalies. D closely resembles C, but is distinguished by its solubility in alkalies. E is remarkable for being soluble in a boiling solution of acetate of soda. These three are brown powders. That portion of the mass soluble in alcohol and alkalies, but insoluble in ether, was not examined, as it was sure to contain some of the peculiar resinous product of decomposition, which is always formed by the action of caustic alkalies on alcohol, and which is supposed to be identical with the so-called "aldehyde resin." The author's analyses of these five bodies led to the following formulæ:—

A	.	.	.	.	.	$C_{62}H_{39}NO_8$
B	.	.	.	.	.	$C_{52}H_{35}NO_8$
C	.	.	.	.	.	$C_{28}H_{11}NO_4$
D	.	.	.	.	.	$C_{56}H_{24}N_2O_{10}$
E	.	.	.	.	.	$C_{28}H_{11}NO_6$

The author attaches no importance to these formulæ, except in so far as they furnish a means of explaining the mode in which these bodies are formed. It will be seen that they all contain the elements of indigo blue, alcohol, and acetic acid in various proportions. Taking as an instance the body C, which is the simplest in constitution, it is apparent that it has been formed by the union of 1 atom of indigo blue, 1 atom of alcohol, and 2 atoms of acetic acid, 8 atoms of water being at the same time eliminated, since



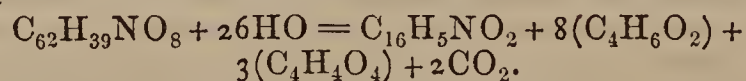
In like manner E originates from the combination of 2 atoms of indigo blue, 1 atom of alcohol, and 5 atoms of alcohol, for



The formation of B will be easily understood by a glance at the following equation:—



In the case of A, which is the most complex of all, it is necessary to assume that carbonic acid comes into play, since



It is difficult to say whence this carbonic acid is derived, but the author supposes it may originate in the decomposition of that portion of the indigo blue which yields anthranilic acid. Hence it appears that all these products, except anthranilic acid, are formed by a very simple process, which consists merely in indigo blue taking up alcohol and acetic acid in various proportions and forming compound bodies in which none of the constituents, as such, can be detected. It is, therefore, not a process of decomposition, but a synthetical process, a building up of complex bodies from others of a simpler constitution. This is proved by the fact of water being given up during the process, whereas in all cases in which complex organic substances are decomposed into simpler ones, water is absorbed. Regarding the real constitution of these bodies the author hazards no speculations. It might be supposed that they belonged to the class of conjugated compounds, of which organic chemistry furnishes us with so many examples, and that by decomposition we should be able to obtain from them some of the simpler bodies which are known to have entered into their composition, but the author's experiments, as far as they have gone, do not countenance this view. He was unable to obtain from any one of them either indigo blue, alcohol, or acetic acid. The occasional disappearance of the indigo blue in the woad vat in consequence of mismanagement now admits, the author thinks, of an easy explanation. By the fermentation of the sugar contained in the madder employed,

alcohol is formed, which in its turn may yield some acetic acid and alcohol, acetic acid and a base (lime) being present, nothing further is required for the development of the process described by the author.

Professor Roscoe suggested that some of the bodies described by the author might possibly be represented as substitution products, one or more of the atoms of hydrogen of the indigo blue being replaced by one or more organic radicles.

A paper was also read "*On Some Physiological Effects of Carbonic Acid and Ventilation*," Part I., by Dr. R. ANGUS SMITH, F.R.S., President.

## ACADEMY OF SCIENCES.

January 30, 1865.

M. BECQUEREL communicated some determinations "*Of the Temperature of the Earth from 1 to 36 Metres Below the Surface, and of the Air up to 21.25 Metres Above the Surface of the Earth*." The author made his experiments with a thermo-electric pile. He finds that the increase of temperature as we descend into the earth is not uniform: for example, the mean increase at a depth of 5 metres was  $0.272^\circ$ ; but after reaching the depth of 16 metres, it was only  $0.102^\circ$  for the next five metres. A difference of  $1.956^\circ$  was found between the temperature at a depth of 1 metre and 36 metres. The author supposes that the irregularity of the increase depends upon the nature of the strata passed through. The experiments made in the air show that the temperature rises with the height, up to 21 metres at least. An interesting fact noticed was, that at 6 a.m. the temperature at four different heights, up to 21 metres, was always sensibly the same at each, varying, of course, from day to day; and the author considers that some relation must exist between the mean annual temperature and that of the air at 6 a.m., at which hour terrestrial and celestial radiation may be supposed to compensate each other. M. Becquerel wishes to carry his experiments to further depths and heights.

MM. Bussy and Buignet communicated some "*Researches on the Reciprocal Action of Cream of Tartar and Sulphate of Lime*." Wine makers in all countries are in the habit of putting gypsum into their wine either before or after fermentation. The custom is a very old one, and nobody can say exactly why they follow it—the wine-maker asserting that the wine is greatly improved by the addition, and the knowing part of the public declaring that the result is most pernicious. A Greek physician once tried to convince us that the gypsum caused next morning headaches. The authors of this paper have been moved to discover what happens when sulphate of lime is brought into contact with bitartrate of potash in an alcoholic mixture, and they have found that the results are neutral tartrate of potash, tartrate of lime, and sulphuric acid, or rather bisulphate of potash.

M. Janssen contributed "*A Memoir on the Telluric Lines of the Solar Spectrum*." It contains the results of some observations made last summer on the Faulhorn. It appears from them that the telluric lines diminish, and the solar lines increase, in intensity the higher the observations are made. This, the author remarks, is quite opposed to the results Mr. Glaisher obtained during a balloon ascent, who observed that the solar lines diminished in intensity the higher he went.

We can only mention the titles of two papers which will be found of interest to physiological botanists—"On Tannin in the Leguminosæ," and "*On the Production of Grapes with a Coloured Juice by Artificial Fecundation*."

M. Moncel contributed some new experiments "*On Electro Magnets with Uncovered Wires*." This paper places the author's previous communications in a somewhat different light. It seems that M. Carlier's machine was made with very impure copper wire of low conducting power.



M. Marignac presented a note "*On Hyponiobic Compounds.*" From a study of the crystallographic relation of various double fluorides of hyponiobium, the author has come to the conclusion that Rose's hyponiobium is not an allotropic modification of niobium, but an oxide of that metal. The author apologises for enunciating this theory without being able to demonstrate its truth, but supports his views by the discordant results of Rose's analyses of the hyponiobic chloride, which, if the compound is regarded as an oxychloride, according to Marignac's views, become quite concordant.

M. Lambron presented a note "*On the Electricity developed in the Sulphurous Waters of Bagnères de Luchon.*" The waters, the author says, when received in a glass or bath, show an excess of positive electricity on the upper surface, and an excess of negative electricity on the lower surface; and when a person is in a bath he completes a circuit, and has a stream of electricity running through him. Moreover, when a patient gets a *douche* of the water, the part of the body soused is negatively electrified, the other parts of the body being positive. Of course the currents must produce a certain action on the animal economy; and it is to be noticed that the waters when transported from their source do not lose their electrical properties.

M. Richer, in a short note "*On a Sulphur Electrical Machine,*" mentions that a disk of sulphur makes an excellent machine for frictional electricity. He melts it and cools it rapidly three or four times, and then moulds it into a disk which may be two or three centimetres thick and a metre in diameter. In reference to this paper, M. Deville recalled the fact mentioned by M. Dietzenbacher some time ago—namely, that the addition of a little iodine or bromine gave great plasticity to sulphur.

## NOTICES OF BOOKS.

*Journal für Praktische Chemie.* No. 22. 1864.

IN a paper "*On the Double Salts of Oxalate of Calcium and Chloride of Calcium,*" by J. Fritsche, the author mentions that he has formed one having the composition  $3\text{Ca}_2\text{O}_4 + 2\text{CaCl} + 8\text{Aq}$ . It is got by dissolving oxalate of calcium in strong hydrochloric acid, which solution on evaporation yields microscopic six-sided prisms of the salt. Two papers by the same author follow, but these have already been noticed in connexion with other journals. A series of communications on chemical technology by Professor Bolley succeed; the first is "*On the Genesis of Silk;*" from the belly of a worm killed at the proper stage, the silk juice may be drawn out and spun into threads coarser and stronger than the animal spins itself. The analysis and properties of the substance showed it to be *fibroin*. When spun by the animal this fibroin becomes partly oxidised and hydrated, and the yellow gum is formed on the surface.

The next article is "*On the Red Colouring Matter of Sapan Wood,*" which the author shows to be identical with the colouring matter of Brazil wood.

Two papers, one by Professor Bolley and another by W. Stein, establish the identity of chrysopikrin, the yellow dye from *Parmelia parietina*, and vulpinic acid the colouring matter from *Cetraria vulpina*.

Professor Bolley also gives an account of the "*Tinctorial Properties of Soga or Cuoa Bark,*" a decoction of which gives a solid brown colour to wool and cotton with tin or alum mordant, and greenish-black with iron mordant.

Dr. Piccard describes a new colour-begetting matter, *Chrysinic Acid*,  $\text{C}_{22}\text{H}_8\text{O}_6$ , which he has extracted from the leaf buds of various species of poplar, *Populus monilifera*, *nigra*, and *pyramidalis*. A concentrated tincture is precipitated with basic acetate of lead, and the precipitate washed, decomposed, &c., as usual. After several puri-

fications, the acid is obtained in colourless crystals. Several salts of the acid are described. Solutions of the acid quickly turn yellow at the ordinary temperature, and orange coloured if heated. The author gives some reasons for supposing that chrysinic acid stands in some relation to chlorophyll.

*Chemisches Central-blatt.* Nos. 1 and 2, 1865.

ALTHOUGH we are in general enabled to keep in advance of this very useful journal with much of its information, we are nevertheless often indebted to it for extracts from periodicals which do not reach us. Most of the papers in these two numbers have, then, already been noticed in the *CHEMICAL NEWS*; but several short extracts will find a place in our columns under their proper heads. Communications by Batka, "*On the Wax of the Sumachs;*" by Dr. Dullo, "*On the Adulteration of Wax;*" and "*On Silk and Wool,*" by Grothe, and others of interest, we shall translate for an early number.

*Zeitschrift für Chemie und Pharmacie, &c.* December, 1864.

THE only paper in this number we need notice is "*A Contribution to the Knowledge of Albuminous Matters,*" by F. Hoppe Seyler. It is, however, little more than a synopsis of the albuminous matters of the body which have been distinctly separated and recognised. Among them the author places the amyloid substance found in the liver and other organs.

In future this journal will be edited by Hubner, with the co-operation of Beilstein and Fittig, whose announcement leads us to expect considerable changes in the contents. Under Dr. Erlenmeyer these have consisted principally of extended essays on theoretical subjects, and long accounts of original researches. The new editors promise short articles on all novelties.

## NOTICES OF PATENTS.

1334. *Preparing Cements Applicable in the Making of Mouldings on Wood.* P. G. ETESSE, Paris. Dated May 30, 1864. (Not proceeded with.)

FOR internal work the inventor uses a composition made of "double size" melted by a gentle heat and mixed with half its weight of plaster of Paris and a small quantity of soddened paper or paper pulp. These ingredients are modified by the introduction of Roman cement when required for external application.

The toy manufacturers make use of a somewhat similar moulding material composed of plaster of Paris in combination with the short cotton fibres which the paper-makers find unserviceable, and sell under the name of "rag dust."

1349. *Treatment or Distillation of Bituminous Substances.* J. YOUNG, Bucklersbury, London. Dated May 31, 1864.

IN the distillation of bituminous substances, with the view of obtaining oils and volatile products therefrom, the inventor employs as the source of heat a current of hot permanent gas, which, being devoid of oxygen or other active elements, cannot exert any destructive action upon the hydrocarbons or other volatilised products given off during the treatment.

Nitrogen would, under ordinary circumstances, be the permanent gas selected; and the inventor prefers to arrange a number of retorts in series. For the removal of the oxygen from air a passage over red-hot charcoal or iron, or a mixture of these, would be effectual; and the process seems capable of modification by substituting hydrogen for nitrogen, when the gaseous products would probably be worth collecting.



1360. *Singeing Yarns and Fabrics.* H. AMBLER, Halifax.  
Dated June 1, 1864.

THE inventor states that when employing a gas flame for the purpose of singeing off the loose fibres of yarns and fabrics, it is better to cause a blast of air to blow on to such flame than to mix the gas and air before ignition, and that a more intense heat is the result.

It is very probable that the flickering nature of the gauze burner renders it unfit for this special application, although its heating power may not be actually inferior to the gas arrangement above described.

1362. *Manufacture of Chromic Acid and Chromates.* F. O. WARD, Hertford Street, Mayfair, London. Dated June 1, 1864.

IN the fusion of chrome ore for the purpose of producing chromic acid or an alkaline chromate, the inventor adds a small proportion of fluor spar, or other compound of fluorine, whereby the reduction of this very refractory mineral is greatly facilitated.

1366. *The Manufacture of Ferro Manganese and Cupro Manganese, and the Combinations or Alloys thereof, with other Metals.* O. E. PRIEGER, Manchester. Dated June 2, 1864.

THE inventor obtains certain useful alloys of manganese, with iron and copper respectively, by reducing the crude oxides of manganese with carbon, in contact with copper or iron. Several modes of operating are described in the specification.

## CORRESPONDENCE.

### Continental Science.

PARIS, February 3.

VITAL statistics possess an interest for every one, and a note from M. Jean Dollfus, of Mulhouse, may perhaps be read with profit by many subscribers to the CHEMICAL NEWS in Manchester. The firm Dollfus and Co. employ 1150 women in their factories, and the firm pays the wages of every woman lying-in for six weeks, so that she may take the necessary care of her infant. They were stimulated to this by the sacrifice of infant life, which appeared to arise either from the necessities or neglect of the parent. The mortality of infants has always been higher in Mulhouse than other parts of France, but the philanthropic efforts of one firm has reduced the mortality, so far as their own *employés* are concerned, 13 per cent.

There is another matter which interests many people—the consequences of marriages between relations. All know the ideas that are commonly entertained on this subject, both in this country and in England, but M. Voisin, of Batz, communicated to the last meeting of the Academy the results of forty-six marriages contracted by cousins of different degrees, from which it appears that all these marriages have been fecund, that the offspring live and grow well developed and in good health—in fact, none of the evil consequences which have been ascribed to intermarriages have been found to spring from these unions.

I may mention here that the manufacturers of Mulhouse have petitioned for a Factory Act to prevent women and children under eighteen from working between ten at night and five in the morning.

Lenoir's gas engine is being employed in Paris for raising building materials, for which one or two horsepower is found very efficient and economical.

Your photographic readers may be glad to know that a grand international photographic exhibition will open at Berlin on the 15th of May next. All objects for exhibition, which may include pictures, chemicals,

cameras, indeed, everything concerned in the art, must be delivered at Berlin on or before the 1st of May.

At the last meeting of the Academy the newly-elected member, M. Leon Foucault, took his place. M. Foucault is a favourite at the Tuileries, and elected on the 23rd of January, the decree confirming his election was signed on the 25th. Such promptitude, it is said, was never shown before. More than this, when the newly elected academician accompanied his brother members of the Bureau des Longitudes to the palace to present the *Annuaire* the Emperor took M. Foucault by the arm, and held a short conversation with him.

## MISCELLANEOUS.

**Chemical Society.**—The next meeting of this Society will be held on Thursday, February 16, at 8 o'clock, when the following papers will be read:—"New Reaction for Preparing Anhydrides and Ethers," by Mr. J. Broughton. "Chemistry of Calabar Bean," by Dr. Fraser. "Action of Silicate and Carbonate of Soda on Cotton Fibre," by Mr. Crace Calvert. "New Electric Lamp Regulator, &c.," by Mr. S. Highley. "Oxidation of India-rubber," by Mr. J. Spiller.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday and Thursday, February 14 and 16, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 17, at 8 o'clock, W. Huggins, Esq., "On the Physical and Chemical Constitution of the Fixed Stars and Nebulæ." Saturday, February 18, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

**Suggestions to Patentees.**—We copy the following remarks from the judgment of the Lord Chancellor in *Simpson v. Holliday* for the information of those of our readers who are or may become patentees. Coming from such an authority, the suggestions merit the earnest attention of inventors:—"Cases of this nature frequently give rise to complaints of the state of the law. It is, therefore, right to point out how entirely the plaintiff's failure has arisen from not availing himself of the salutary provisions of the existing statutes. The provisional specification proves that a valuable discovery had been partially made, but not matured; and that the true conditions on which it might become an invention of practical utility had not been ascertained. Six months are allowed by the law for maturing the invention and accurately ascertaining and stating it; but in this case there does not appear to have been any attempt by the patentee to improve his knowledge; for the complete specification is a mere repetition of the provisional. Lastly, the inefficiency of the cold process, and the dangerous language of the specification, must have been known long prior to this suit, and yet there was no attempt to remove the objection, as might easily have been done by a disclaimer under the statutes."

## ANSWERS TO CORRESPONDENTS.

\* \* All *Editorial Communications* are to be addressed to the EDITOR, and *Advertisements and Business Communications* to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

R. H.—We cannot say where you will find an account of Hearder's and Ladd's latest improvements in the coil.

T. W.—Received with thanks. The errors shall be corrected when inquired into.

J. Y. S.—1. We think it probable that you might succeed; but the first qualification required in a salaried *employé* is practical experience. We cannot offer advice, but may remark that it is possible to pursue commerce and science together.

Received.—P. Le Neve Foster.

Errata.—No. 270, p. 50, col. 2, line 3 from bottom, for "commercial," read "concentrated." Page 59, col. 1, line 29 from top, for "hours," read "horses."



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.

## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION I.—Historical Development of the Ideas, Equivalent, Atom, Molecule.

(Continued from page 49.)

**Multiple Proportions.—Atoms.**—The idea of atoms arises from a fundamental discovery which was made about 1804 by Dalton, and which depends upon facts entirely distinct from those observed by Wenzel and Richter. Having studied the composition both of olefiant and of marsh gas, Dalton perceived that for the same quantity of carbon, the latter contained exactly double the quantity of hydrogen which was contained in the former. He made analogous observations concerning the composition of carbonic oxide and carbonic acid, and of the compounds of oxygen and nitrogen. In this way he discovered the *law of multiple proportions*.

The following is the explanation of this law:—When two bodies, either simple or compound, form several combinations with each other, if the weight of one of them be taken as constant, the weight of the other varies in a very simple ratio. Thus, nitrogen forms five combinations with oxygen. If we take quantities of these compounds containing the same weight of nitrogen, the weight of the oxygen in them will be in proportion to the numbers 1, 2, 3, 4, 5.

For example:—

	Of nitrogen.	Of oxygen.
Protoxide of nitrogen contains for	175 parts	100 parts
Binoxide of nitrogen        ,,	175    ,,	200    ,,
Nitrous acid                 ,,	175    ,,	300    ,,
Hyponitric acid            ,,	175    ,,	400    ,,
Nitric acid                 ,,	175    ,,	500    ,,

The acute intellect of Dalton did not stop at facts, but sought to explain them by devising a theory. Reviving an idea of Leucippus and a statement of Epicurus, he supposed that bodies were formed of small indivisible particles which he called atoms. To this old and vague notion he gave a distinct meaning by admitting, on the one hand, that for every kind of matter the atoms possess a uniform weight, and, on the other, that combination between different kinds of matter is the result of the juxtaposition of their atoms. This fundamental hypothesis being admitted, the fact of definite proportions and of multiple proportions finds a simple and satisfactory explanation. The definite proportions according to which bodies combine represent the unvarying relations between the weights of the atoms which are in juxtaposition; and if a body can combine with another in several proportions, such multiple combinations can only be effected by the juxtaposition of 1, of 2, of 3, of 4, &c., atoms of one body and one or several atoms of another body. The evident result is, that if the weight of this latter body is constant, the weights of the other in the different combinations ought to be multiples of one another.

As immediate consequences of these propositions, Dalton inferred that the atomic weight of a compound body was formed by adding together the atomic weights of its elements, and that the definite proportions according to which compound bodies, such as acids and bases,

combine, represent merely the uniform relation between their atomic weights. Thus the laws of Wenzel and Richter are seen to be only particular cases of a general law which governs the composition of all bodies. The atomic hypothesis explained them at once.

But these atomic weights have no absolute value; they only represent the proportions according to which bodies combine. An unit must be chosen as a term of comparison. Dalton referred all the atomic weights to that of hydrogen, which he called 1. In a work entitled *A New System of Chemical Philosophy*, published in 1808, he gave the following table:—

	Dalton's atomic weights.	True numbers.
Hydrogen . . . . .	1	1
Nitrogen . . . . .	5	7
Carbon . . . . .	5	6
Oxygen . . . . .	7	8
Sulphur . . . . .	13	16
Magnesia . . . . .	20	20
Lime . . . . .	23	28
Soda . . . . .	28	31
Potash . . . . .	42	47.1
Strontia . . . . .	46	51.8
Baryta . . . . .	68	79.5
Iron . . . . .	38	28
Zinc . . . . .	56	32.6
Copper . . . . .	56	31.7
Lead . . . . .	95	103.5
Silver . . . . .	100	108
Platinum . . . . .	100	98.7
Mercury . . . . .	167	100

Thus, for a certain number of bodies Dalton's numbers come very near to theory. This accordance is still closer in a table published by Wollaston in 1814,\* in which the atomic weights, or rather the equivalents (to use Wollaston's term), are referred to that of oxygen, which is taken as 10.

(To be continued.)

#### Purification of Commercial Arseniferous Hydrochloric Acid,† by M. AUG. HOUZEAU.

IN the preparation of weak acid it is only necessary to boil the commercial arseniferous acid in a flat-bottomed dish until the acid is reduced to two-thirds of its original volume. By allowing the hydrochloric gas to escape without collecting it, all the arsenic is taken with it in the form of chloride (AsCl<sub>3</sub>), and the liquid remaining in the dish is no longer arseniferous; eight litres of commercial acid, treated in this way, furnish in less than three hours two litres of weak acid free from arsenic.

**Preparation of Fuming Acid.**—The apparatus required for this operation consists of a flat-bottomed vessel of six litres capacity, into which first pour three litres of arseniferous acid, and add 0.3 gr. of powdered chlorate of potash (0.1 gr. per litre). Then adapt to the mouth of the flask a cork pierced with two holes, into one of which fit a straight and strong safety tube; and into the other a larger tube, of the diameter used in organic analyses, 0.5 m. long, and serving, so to speak, as a vertical elongation. This lengthened tube should be very little tapered at its lower part; fill it with filings of red copper well beaten down (about 100 grms.), to within 0.07 m. of its upper orifice, and then fill it almost entirely with asbestos or broken glass. Pass the greater part of this tube through the neck of the flask, so that as much as possible of the surface may be heated by the

\* *Annales de Chimie*, xc., 138.

† *Comptes Rendus*, lix., 1025. 64.



hydrochloric vapour. Then furnish the upper part of the elongated tube with a tube to carry the gas into a receiver. In traversing the column of copper the acid gas is deprived of its chlorine, and arrives in a pure state in the water destined to dissolve it. The mode of operation is very easily comprehended. By boiling the acid the transformation of the chloride of arsenic into fixed arsenic acid is completed by the decomposition of chlorate of potash; the excess of chlorine is taken with the moist hydrochloric gas into the copper, which most readily absorbs it, in preference to the acid, for which its affinity is much less. The chloride of copper returns to the flask in the form of a solution, while the gaseous hydrochloric acid condenses in the distilled water. But as it is important that there should always be, in the boiling acid, a slight excess of chlorine, to prevent the reduction of the arsenic acid, a constant current of hydrochloric acid, to each litre of which one gramme of chlorate of potash has been added, should arrive through the safety tube (which should not dip more than from three to five centimetres into the liquid) so as always to maintain a small excess of chlorine, and at the same time to replenish the flask with hydrochloric acid to be purified. Generally the proportion of liquid acid thus added should be greater than is required for distillation, otherwise there might be an insufficiency of chlorine. When the experiment has been successfully performed the hydrochloric acid contains neither arsenic nor chlorine.

By in some degree modifying this apparatus pure hydrochloric acid may be constantly obtained without any sensible loss of acid, and the process may then be applied commercially.

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*The Electro-chemical Properties of Hydrogen,*  
by M. CROVA.

HYDROGEN, rightly called by M. Dumas a gaseous metal, is distinguished from all the other bodies in the range of chemistry by a number of very remarkable physical and chemical properties.

A metallic plate covered with hydrogen proceeding from the decomposition of an electrolyte possesses an electro-motive force varying with the intensity of the current, that is to say with the amount of gas disengaged in a given time at the surface of this plate, and which may be calculated exactly by means of a logarithmic formula.

When mercury containing a small but variable quantity of oxidisable metal is employed as the negative metal of a pile, the electro-motive force diminishes rapidly with the quantity of oxidisable metal contained in the amalgam, provided the quantity is very small.

The hydrogen disengaged at the surface of a metallic plate is always more or less in a condition similar to that of an oxidisable metal contained in minimum proportion in an amalgam.

Mercury, which has served as a negative electrode in the decomposition of water, has the property of disengaging when heated bubbles of hydrogen, and substituted for the zinc of a pile it exhibits all the behaviour of an oxidisable metal in which the proportion of this metal would be extremely small. Very pure mercury through which a current of ordinary oxygen has passed does not sensibly differ from simple mercury; but this same mercury after having been submitted to the action of a current of hydrogen proceeding from the decomposition of water by the pile at a low temperature, and containing consequently traces of Ozann's allotropic hydrogen, presented, though to a very slight degree

properties analogous to those of mercury, which has served to disengage hydrogen electrolytically.

The author has repeated these experiments by cooling the mercury to about  $20^{\circ}$ , and has succeeded in slightly increasing the quantity of hydrogen absorbed by the mercury, but the amount is nevertheless very small.

An amalgam of zinc plunged in diluted sulphuric acid disengages hydrogen. At the ordinary temperature this disengagement is very slow, on account of the very slight difference existing between the electro-motive force of the zinc and that of the hydrogen. When the zinc has been recently amalgamated the surface is covered with a slight layer of liquid amalgam, which on account of the perfect polish of its surface renders the disengagement of hydrogen very difficult. But after a certain time the mercury and the zinc combine more intimately and form a crystalline amalgam. The amalgamated zinc then loses its brilliancy, and plunged in diluted sulphuric acid disengages hydrogen sensibly; the surface of the metal, roughened by the crystallisation of the amalgam, favours the disengagement of hydrogen.

We know that a plate polarised by hydrogen still manifests a feeble polarisation when washed and rubbed with emery paper. The current given by an unpolarised platinum plate, associated with another plate polarised by hydrogen, quickly becomes weaker, and is after a time extinguished. If the circuit is then broken, and after a certain time the communication is re-established, the current reappears, though more feebly, and this phenomenon may be several times repeated.

The author disengaged hydrogen by means of the pile on one face of a very thin platinum plate, the posterior face of which rested in a bath of diluted sulphuric acid, and was placed opposite a second platinum plate perfectly unpolarised. Though no hydrogen is disengaged on the first plate its posterior face put in communication with the second plate by the wire of a galvanometer detects no current. When hydrogen is disengaged on the first plate its posterior face, put from time to time in communication with the second plate, still shows no current, but after a time varying according to the thickness of the plate, the posterior face manifests increasing signs of polarisation by hydrogen. If by reversing the current of the pile oxygen is disengaged on the first plate, all trace of polarisation disappears from the posterior face, and these alternations may be repeated any number of times. This experiment, which the author has varied in many ways, seems to him to prove that platinum is electrolytically permeable to hydrogen. The metallic nature of hydrogen seems to him to receive still further confirmation from these facts, and he believes that the generalisation of this idea may prove of value in explaining various electro-chemical phenomena.—*Les Mondes*.

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*On the Supposed Nature of Air prior to the Discovery of Oxygen,* by GEORGE F. RODWELL, F.C.S.

J E

(Continued from page 39.)

In Obs. 16 "Of charcoal or burnt vegetables," Hooke propounds his celebrated theory of combustion, a most philosophical and ingenious theory, and far in advance of the chemical knowledge of the day.

From very ancient times, fire was believed to be an element more divine than air, water, and earth, and to occupy a place above them; we find this theory in the most ancient Vedas, in the Zend Avesta, and in the writings of Sanchoniatho; indeed, we know that fire was the divinity of the Zoroastrians, and first invoked



among the deities of the ancient Hindus, was Agni, the god of light and fire. Fire was universally believed to be an element till the time of Bacon, and almost universally for many years afterwards: Bacon,\* in his investigation of the nature of heat, denies that it is elemental, and states his belief that it is "merely compounded of the conjunction of heat and light in any body;" heat, he elsewhere affirms, is a violent motion of the smallest particles of bodies, and heat can produce light, hence he completely destroyed the elemental nature of fire. Hooke went much further than this, for his theory affirmed:—

1. That the air is the "universal dissolvent of all sulphureous bodies."

2. That the dissolution does not commence until the body to be dissolved has been heated to a certain temperature.

3. That the process of dissolution generates that which we call *fire*.

4. That the process of dissolution is performed with such intense violence that it agitates the smallest particles of the combustible matter, with sufficient rapidity to generate "the action or pulse of light."

5. That the solution of sulphureous bodies is made by "a substance inherent and mixed with the air, which is like, if not the very same, with that which is fixed in saltpeter."

6. That in the process of dissolution a part of the combustible body is turned into air, and caused to move with it.

7. That in the process of dissolution a part of the combustible body is not turned into air, but is carried up by the motion of the hot air, and when the heat ceases descends again, and this part is a certain kind of salt found in soot.

8. That in the process of dissolution certain bodies capable of being dissolved are carried upwards, and do not suffer dissolution, because the motion of the surrounding air does not allow them to remain sufficiently long in a heat competent to cause them to be acted upon by the air, and this is the combustible part of soot.

9. That there are parts of the combustible body which cannot be dissolved by the air, and are not sufficiently light to be carried upwards by the motion of the hot air, and this constitutes the ash of burnt bodies.

10. That "the dissolving parts of the air are but few," they soon become satiated, and the combustible body then ceases to be acted upon, until it is supplied with a fresh quantity of air; but in saltpetre the dissolving particles abound in great quantity, hence this body is able when melted to rapidly dissolve a large quantity of a combustible body.

11. That as with liquid solvents if we repeatedly add fresh quantities of a weak solvent, the body to be dissolved disappears as quickly as if a strong solvent be added all at once, so if we supply fresh quantities of air repeatedly, as by bellows, to a body undergoing combustion, it suffers solution as quickly as when it is placed in melted nitre.

12. That there is no such thing as an "element of fire," for the "shining transient body which we call flame is nothing else but a mixture of air, and the combustible volatile parts of any body, which parts the encompassing air does dissolve or work upon."

This theory had been worked out by Hooke several years earlier, and was well supported by experimental facts; it is much to be regretted that he does not give any of the experiments, neither has he in any future

publication enlarged or developed the theory, although he states that he has here "only time to hint an hypothesis, which, if God permit me life and opportunity, I may elsewhere prosecute, improve, and publish." Assuredly if he had adduced experiments in support of his assertions, the theory of four elements would now have been annihilated; but this, earliest amongst the physical conceptions of the human intellect, was not yet destined to receive its death-blow; that which had dwelt so long in the human mind, had taken such deep root therein, had endured uninjured through the greatest changes of intellectual development, the greatest changes in the tone and mode of thought, had seen the downfall of old systems of philosophy, the rise of new ones, could not so easily be displaced from the minds of men. Many years must pass; experiments must be accumulated; chemistry must free itself from empiricism and become a science; the Phlogistic theory must arise, and be vanquished by a Lavoisier, before that change can take place.

In the 58th observation of the "Micrographia" Hooke treats "of a new property of the air." It is constantly observed, he writes, that the sun and moon, when near the horizon, have their images distorted, and assume a red colour; moreover, trees and other objects are sometimes observed to possess an unsteady appearance at sunset; these effects he attributes to the "inflection or multiply refracted of those rays of light within the body of the atmosphere." That the refractive power diminishes with its rarefaction, Hooke proved by viewing an object through a hollow glass sphere, containing much rarefied air, and then admitting air; the object was viewed through an aperture placed in front of the sphere, of such a size that every part of the object was just included in the field of view; on now admitting air to the interior of the sphere, a part only of the object was visible.

We know that the air is less dense the further it is from the surface of the earth, from the fact that the mercury column sinks in a barometer as we ascend a mountain; and, he continues, the law regulating the descent of the mercury may be illustrated by "a means which somewhat since I thought of, and used, for the finding by what degrees the air passes from such a state of density to such a degree of rarity." He next details a number of experiments—made with precisely the same apparatus as that employed by Boyle—which prove conclusively that the volume of air varies inversely as the pressure to which the air is submitted.

It is remarkable that Hooke does not mention Boyle's name in connection with the law, although in the "Defence against Linus," published more than two years previously, Boyle (as we have seen in a former paper) gives a number of experiments clearly proving the law; moreover, he had described his experiments at several meetings of the Royal Society in the presence of Hooke. We cannot imagine that Hooke wished to give Boyle less than his due, for he constantly mentions suggestions which he received from him, and always speaks of him in the highest terms. In the preface to the "Micrographia" he speaks of "the most illustrious Mr. Boyle, whom it becomes me to mention with all honour, not only as my particular patron, but as the patron of philosophy itself;" again, he speaks of "the incomparable Mr. Boyle." It is also remarkable that Boyle does not mention Hooke's name in connection with the law, for the former is always most ready to acknowledge the discoveries and inventions of others. It is impossible to say who first verified the law; at all events, Boyle

\* "Nov. Org.," Book 2, Aph. 20



was the first to suggest that the experiments should be made, and to describe a method for making them. Hooke speaks of his own experiments as confirming the law, not as giving rise to it; indeed, both he and Boyle attribute the idea that "the pressures and expansions are in reciprocal proportions" to a Mr. Richard Townley. We must remember that at the time of the discovery of the law the air was the only gaseous body known, and a law which had been proved to apply to one body would obviously be considered of a less importance than one which applied to a whole class of bodies. It is to this that we must attribute the fact that no trouble was taken to ascertain the true history of the law by those writers who lived at the time of its discovery.

The history of the law, as far as I have been able to trace it, seems to be the following:—

1660.—Boyle, in his "Physico-Mechanical Experiments," suggests a method for determining the relation of the density of air to the height of the column of mercury which it supports.

Townley, after reading Boyle's suggestion, makes some experiments on the subject, which induce him to propound the theory that "the pressures and expansions are in reciprocal proportions."

Hooke, not having heard of Townley's theory, makes some experiments, but without finding that "the pressures and expansions are in reciprocal proportions."

Mr. Croune and Lord Brouncker make some experiments on the subject.

1661 (August 2).—Hooke, having heard of Townley's theory, makes some further experiments by a different method, which confirm it.

September 11.—Croune gives an account of his experiments on the subject before the Royal Society.

Boyle, at the same meeting of the Society, describes some experiments previously made, which confirm the theory.

1662.—Boyle, in his "Defence against Linus," publishes a detail account of the experiments described before the Royal Society in the previous year, and affirms that "an accurate experiment of this nature . . . has not yet been made, (that I know,) by any man."

1665.—Hooke publishes in detail the experiments made on August 2, 1661.

1676.—Mariotte, in his "Essai sur la Nature de l'Air," publishes some experiments made by himself and a M. Hubin, which confirm the law.

I must still adhere to the opinion expressed in a former paper, that the law which affirms that the volume of a gas varies inversely as the pressure to which the gas is submitted is rightly "the law of Boyle."

Hooke, not only by his writings, but by inventing and improving many philosophical instruments, eminently benefited experimental science. Now that the old philosophy was to be expelled from the minds of men, now that Nature was no longer to be interrogated by the unaided senses, it was necessary that there should be instruments to assist the inquirer. Hooke was the very man that was wanted at the time; a good mathematician, possessing admirable inventive faculty, and a patient experimenter. He was a greater mechanical genius than Boyle, but I will not say a more ardent experimenter. Both were worthy to put in practice the tenets of the new philosophy; both were true types of the Baconian philosopher: their names will never disappear from the annals of science, will never cease to be revered by all true students of Nature.

## TECHNICAL CHEMISTRY.

*On the Revivification of Animal Charcoal*, by HENRY MEDLOCK, Ph.D., F.C.S., M.P.S.

THE principal source of expense in a sugar refinery is that of animal charcoal; and it is a great desideratum to the refiner, commencing with the use of new animal black, to adopt a means of keeping his coal in good condition, and retaining, unimpaired, its decolorising powers after each successive use. I will treat the subject very briefly under the following heads:—

1st. The composition of bone and animal charcoal.

2nd. Its decolorising property, and the causes of its becoming inactive.

3rd. The means of restoring its primitive powers of absorption and decolorisation.

**I. The Composition of Bone and Animal Charcoal.**—Bone, as is well known to anatomists, is a solid structure composed principally of phosphate of lime and osseine, a modified form of gelatine. The phosphate of lime, or solid portion of the bone, is composed of an infinite number of minute, almost microscopic cells, which are filled up by osseine, and bound thereby, as with a cement, into a solid mass.

The composition of bone, after the removal of adhering fat by boiling, is as follows:—

Phosphate of lime	.	.	.	63.1 per cent.
Carbonate of lime	.	.	.	1.4 "
Phosphate of magnesia	.	.	.	2.1 "
Other salts	.	.	.	2.4 "
Osseine	.	.	.	31.0 "
				100.0

When submitted to heat in a closed vessel, to which air cannot gain access, the osseine is decomposed, evolving oily and ammoniacal products, which are, by suitable arrangements, collected and applied to many useful and economical purposes. In the retort remains the cellular structure of the bone in a most porous condition, each cell and pore being coated with a thin film of finely divided carbon, resulting from the decomposition of the organic osseine.

The purely chemical reasons why the porous animal charcoal should possess such extraordinary decolorising and general absorptive properties, is a question I need not now enter into, but I shall do so fully in a forthcoming pamphlet.

**II. The Decolorising Properties of Animal Charcoal, and the Causes of its Becoming Inactive.**—It is well known to the refiner that his charcoal too soon loses the power of decolorising his syrups, and the question arises, what is this owing to? It is *a priori* assumed that it is owing to the grains of coal becoming coated on the surface with the slimy albuminous and mucilaginous matters contained in the raw sugar, which destroy to a great extent its porosity. This is doubtlessly one cause, but the principal, and by far the most serious cause is the presence of lime in the raw sugar; and which, in a short time effectually chokes up the pores, and, in the process of reburning, cannot be removed, although the mucilaginous materials are destroyed.

**III. The Means of Restoring its Primary Powers of Absorption and Decolorisation.**—When the charcoal ceases to decolorise, it is usually washed with hot water to remove the syrup remaining therein, and then reburned in closed furnaces of various



construction, the object of reburning being to carbonise the colouring matters extracted from the syrups. This restores to some extent the decolorising powers of the charcoal; but at each successive re-burning the coal continues to lose its properties, and at last ceases altogether to act as a decoloriser, unless it be mixed, after each re-burning, with a certain portion of new charcoal.

Another process, and one frequently adopted, is to destroy the organic matters by keeping the charcoal in water, and allowing it to ferment for several days, draining off the water, and adding fresh water containing about  $\frac{1}{4}$  to  $\frac{1}{2}$  per cent. of hydrochloric acid. The little acetic acid formed and the hydrochloric acid added, dissolve a small quantity of lime, and so far act beneficially. But the good effect is more than neutralised by the fact of the acids attacking the structure of the bone itself—namely, the phosphate of lime, thus rendering the coal friable, and consequently making much dust and waste.

Having referred to the two methods in common use of revivifying the decolorising powers of charcoal, and alluded to their inutility and defects, I will describe a new method, as simple as it is ingenious, of rendering old and comparatively useless charcoal as good, and, indeed, better than new. Corenwinder, an eminent German chemist, has, by numerous experiments, established this axiom—namely, "That the decolorising power of charcoal used in sugar refining is correlative to its power of absorbing lime." In other words, the more the pores of the coal become choked up with lime, the less is its power of decolorising. Now, to remove the obnoxious lime without attacking the structure of the bone itself, is a question which has occupied for many years the ingenious mind of my friend, Edward Beanes, C.E., F.C.S.

Mr. Beanes, who, by his chemical researches on the sugar plantations of Cuba, has enabled the planters not only to produce much finer qualities of sugar, but considerably to augment their produce, has recently patented a process of restoring to charcoal its primitive properties of decolorising syrups. Mr. Beanes found that charcoal, perfectly dry, and hot, absorbs dry hydrochloric gas with the greatest avidity and in enormous quantity. The gas combines with the lime and converts it into soluble chloride of calcium. After the charcoal has been treated with gas, a portion of untreated charcoal is mixed up with it; the uncombined gas remaining in the pores of the former is taken up by the latter, and the whole becomes neutral; the chloride of calcium is then washed out—requiring only a few hours—and the charcoal is afterwards reburned in the usual way. It is then found that the decolorising power of the charcoal is augmented at least 100 per cent.

The advantages of Mr. Beanes' process are as follows:

- 1st. It removes the whole of the lime and carbonate of lime from the pores without attacking the phosphate.
- 2nd. It augments the decolorising powers of the coal upwards of 100 per cent.
- 3rd. It requires no expensive apparatus, and the process is almost costless, two saleable products being obtained nearly equal in value to the materials employed.

I have thus ventured to introduce Mr. Beanes' process to the notice of English refiners, not simply from feelings of personal friendship, but from the firm conviction that by its general adoption he will confer as great a benefit on his own countrymen as he has already conferred upon the sugar manufacturers of Cuba.

Chemical Laboratory, 20, Great Marlborough Street, London, W.

## PHARMACY, TOXICOLOGY, &c.

*Manufacture of Perchloric Acid, by*  
CHARLES BULLOCK.\*

HAVING occasion to prepare perchloric acid in some quantity, the process of M. Deville for obtaining fluosilicic acid was tried as a preliminary step.

The process of M. Deville consists in passing steam through a mixture of fluorspar and silica heated to redness. The water is decomposed with the production of hydrofluoric acid, which takes up silica, and fluosilicic acid distils over.

In the first experiment an iron retort was used, and in place of passing steam through the mixed ingredients, water was allowed to drop slowly on the hot materials through a safety tube. A small amount of weak acid was obtained, after which water distilled over. In the second experiment, the tube for introducing water was carried to the bottom of an iron retort. After a small amount of very weak acid had distilled over, the distillation ceased. An examination of the retort showed that the iron tube passing through the materials in the retort, as also the retort, had fused. The iron had evidently melted below its usual fusing point, owing to the fluorspar acting as a flux.

Another experiment was made with an earthen retort of half a gallon capacity. A porcelain tube was passed through the tubulure of the retort to within an inch of the bottom. Fluorspar and silica, broken into fragments of the size of large peas, were introduced into the retort, which was placed in a wind furnace, and a suitable condensing apparatus connected. When the retort had reached a full red heat, steam was introduced from a steam boiler, by means of suitable connexion. For a short time the process promised well, then ceased.

An examination of the contents of the cold retort showed that the hot silica had been disintegrated by the steam sufficiently to pack the mass too tight for the vapour to penetrate it.

With this experience, I resorted to the process I had before employed for perchloric acid, which, although it claims no novelty, may interest some readers of the journal from its details.

The first step, to obtain perchlorate of potash, is as follows:—

Heat in a porcelain crucible of eight ounces capacity, over a gas furnace, eight ounces of chlorate of potash, until the salt is in complete fusion, taking care that but little or no oxygen is evolved. Then cover the crucible and continue the same amount of heat till the fused salt thickens and crusts entirely over on top. A portion of the salt removed from the crucible should now impart but a light yellow colour to pure undiluted muriatic acid. The crucible is now removed, and allowed to cool. When cold, the fused mass detaches itself completely from the crucible by turning it upside down.

Dissolve the mass in two and a-half pints of boiling water. The perchlorate of potash crystallises out on cooling, and should be washed with water to separate the mother water.

The loss of weight by heating the chlorate of potash was about two ounces in each pound. Amount of perchlorate of potash obtained from a pound of chlorate, about eight ounces. Four hours' heating was required for eight ounces of chlorate of potash, the gas flowing through a six-foot burner to about three-fourths of its capacity.

\* *American Journal of Pharmacy.*



Perchlorate of potash is the most insoluble of all the salts of perchloric acid, requiring sixty-five times its weight of water, at 60° F., for solution.

To obtain perchloric acid from perchlorate of potash, the salt is distilled (below the boiling heat of the ingredients) with twice its weight of sulphuric acid mixed with one-tenth part of water, as long as any distillate is obtained. The distillate, containing perchloric and sulphuric acids, together with some free chlorine, and a little hydrochloric acid, is treated with carbonate of lead rubbed into a paste with water, till baryta water no longer disturbs the clear solution. Should an excess of carbonate of lead have been used, the perchlorate of lead is to be carefully decomposed by sulphuric acid. The weak acid is now filtered from the sulphate and chloride of lead, and a few drops of hydrosulphuric acid added, to decompose the slightly soluble chloride of lead. After boiling, the acid is again filtered, and may now be concentrated in an open capsule below boiling until it attains a specific gravity of 1.6, or thereabouts, when it commences to give off white vapours. By distillation of this product an acid having the density of 1.693 is obtained.

One pound of perchlorate of potash yielded five ounces of acid of a density of 1.210.

The properties of perchloric acid have been so fully described by Professor Roscoe (vol. xxxiv., p. 64, of this journal), that further notice is unnecessary.

The effect of this acid, sp. gr. 1.693, was tried on the following articles: With morphia, codeia, narcotina, and atropia; no reaction. With meconia, flesh colour; quinia, pale straw colour; strychnia, pale yellow; brucia, rose colour; delphia, a dirty red colour; aconitia, a light ochry yellow; digatalin, snuff brown.

**Perchlorate of Morphia.**—Dr. Ogden, in his analysis of chlorodyne, claims perchlorate of morphia as one of its ingredients. The following short notice of this salt are the results of some experiments made to ascertain its character:—It crystallises in long acicular prisms. Requires seventy-three parts of water, and forty-four of alcohol, at 60° F., for solution. In chloroform it is almost entirely insoluble.

*On Ésérine, the Alkaloid of the Calabar Bean, by MM. A. VÉE and M. LEVEN.\**

THE authors begin with pointing out that the *phytostigmine* of Jobst and Hesse only possesses some of the characters of an immediate principle, and is, in fact, a mixture of several bodies, of which the most considerable is a crystallisable body which they call ésérine. This is obtained in the following way, which, it is said, is a modification of the process of Stas for separating alkaloids in cases of poisoning.

Calabar beans reduced to a fine powder are exhausted by cold alcohol. The alcohol is carefully distilled from the tincture, and the extract is treated with a strong solution of tartaric acid. After some time the mixture is diluted with water, filtered and then supersaturated with bicarbonate of potash. The whole is now shaken with ether, and the etherial solution separated gives on evaporation the alkaloid contaminated with foreign matters. The extract is dried over sulphuric acid, and then re-dissolved in pure anhydrous ether, from which solution the alkaloid is obtained almost pure. Repeated solution in alcohol or ether remove all the impurities, but a little red colouring matter which obstinately adheres.

Ésérine is a crystallisable solid of a faintly bitter taste, which is not immediately perceived. It is freely soluble in ether, alcohol, and chloroform, and but slightly soluble in water. It crystallises in thin rhombic plates, which are coloured by polarised light. The aqueous solution has an alkaline reaction. The alkaloid is soluble in acids; the solution gives all the ordinary general tests for alkaloids. The solution acts powerfully upon the pupil.

## PROCEEDINGS OF SOCIETIES.

### PHARMACEUTICAL MEETING.

Wednesday, February 1.

Mr. HILLS, Vice-President, in the Chair.

(Continued from page 69.)

DR. ATTFIELD communicated the results of an analysis of the kola nut. He sought first for theine. A decoction was precipitated by basic acetate of lead, excess of lead removed by sulphuretted hydrogen, and the clear solution left evaporated to dryness. The residue was digested in hot alcohol, and the alcoholic solution evaporated to small bulk. This, when cold, solidified to a mass of crystals, which were found to possess all the characters of theine. The amount of this body present in the kola nut is 2 per cent. No other acid, basic, or neutral body was found. The fresh nuts have a bitter taste, which the dried do not possess; and the former probably contain a bitter principle to which some of their activity must be ascribed. Starch is present to the extent of 42.5 per cent.; gum, sugar, and an albumenoid substance (probably legumin) are also found, and likewise a small amount of an oil possessing a smell resembling that of myrrh, and a burning, persistent taste. Tannin is entirely wanting in the nuts. The composition of the nuts is shown in the following table:—

	In 100 parts.
Water.	13.65
Cell wall and colouring matter	20.00
Starch.	42.50
Volatile oil	1.52
Fixed fat	
Albumenoid substance.	6.33
Gum	10.67
Sugar	
Other organic matter	
Ash	3.20
Theine	2.13

Dry kola is thus seen to somewhat resemble coffee, but differs in containing no tannin, but little fat, and much starch. When made into a beverage, it is thick and mucilaginous; but is tasteless, odourless, and flavourless, and is not improved by roasting.

### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

January 24, 1865.

R. ANGUS SMITH, Ph.D., F.R.S., &c., President, in the Chair.

DR. R. ANGUS SMITH, F.R.S., read a paper "*On some Physiological Effects of Carbonic Acid and Ventilation*," of which the following is the substance:—That bad ventilation produces effects which are unpleasant, unwholesome, dangerous, or deadly, according to circumstances, has been long known; it has also been well known that the effects of breathing carbonic acid are of a similar kind. We have not, however, been able to say distinctly that the evil effects of bad ventilation are due entirely to carbonic acid. We have had, and not without good reason, a strong belief that the organic matter was a grave offender. The author had endeavoured to show elsewhere that the organic matter is in early stages of ventilation the most observable,

\* Abridged from *Journal de Pharmacie*, &c., January, 1865, p. 71.



but that in later stages the effect of the carbonic acid is unmistakeable. When inquiring into the state of the air in mines he found it needful to make experiments in close places, and had a leaden air-tight room built, containing about 170 cubic feet of air. On examining the effect of carbonic acid on the burning of candles, he remained in the chamber until that gas was poured in to the extent of 3.9 per cent. He then found that the pulse fell so low that it was difficult to count the beats, whilst they diminished in number. This effect was rapid, as he was not long in the room. Since there was no time for the accumulation of organic matter, nearly the whole effect must have been due to carbonic acid. Similar results were observed frequently. A few may be given. The first here adduced will show the fall of the pulse and the increase of the respiration more clearly than the others, as the details are appended. The carbonic acid increased by means of respiration only. The number of beats diminishes with a regularity equal to the increase of the carbonic acid, whilst the breathing quickens with equal steadiness.

ONE PERSON IN THE LEAD CHAMBER.

Respiration and beats of the pulse taken every ten minutes.

Time.	Pulse.	Respiration.	Temperature, Celsius.	Carbonic Acid in the same periods.
h. m.			deg.	
10 55	73	15.5	18.2	0.04
min.				
After 10	73	16	18.2	0.114
„ 20	72	16	18.2	0.187
„ 30	71	17	18.4	0.261
„ 40	71	16	18.4	0.335
„ 50	70	16	18.5	0.408
„ 60	68	16	18.6	0.482
„ 70	67	16.5	18.7	0.556
„ 80	67	17	18.8	0.629
„ 90	66	17	18.9	0.703
„ 100	65	18	19.0	0.777
„ 110	65	18.5	19.0	0.850
„ 120	64	19	19.0	0.924
„ 130	63	19	19.2	0.997
„ 140	62	19.5	19.1	1.071
„ 150	62	20	19.1	1.145
„ 160	62	20	19.1	1.218
„ 170	61	20	19.1	1.292
„ 180	60	21	19.1	1.366
„ 190	60	22	19.2	1.439
„ 200	59	23	19.2	1.513
„ 210	58	24	19.4	1.587
„ 220	57	24	19.4	1.661
„ 230	57	24	19.4	1.734

Five persons sat for 80 minutes in the room. In all cases there was great irregularity of breathing. They were all conversing with each other, which occupation, as was found, somewhat modified the effect. In two cases the rise of the pulse was considerable—viz., from 60 to 79, and from 84 to 91; but the numbers soon fell down to the natural amount, and would apparently have fallen much lower if one of the two persons had not felt too unwell to remain. The pulses in all cases were difficult to count, being excessively feeble, and the most delicate of the fingers was sought for the operation. No deficiency of strength was found in any of the trials, and the amount of carbonic acid rose equally from first to last. As the pulse rose and fell according to the individuality, the author fixed on one young man on whom the effect was most regular for further experiment. It must be remembered, however, that on no person was the effect small or uncertain. The objects of the farther experiments were these,—1st, to inquire if the influence could be observed when the amount of carbonic acid was small; and 2nd,

to separate the effects of the carbonic acid entirely from those of organic matter. With 3 per cent. of carbonic acid evolved in the chamber itself, the pulse fell in 27 minutes from 67 to 62, the breathing rose from 17 to 23; the pulse so low that it was barely perceptible. The exposure was not full 27 minutes, as the gas took some time to evolve. With 2 per cent. the pulse fell in 70 minutes 4, the breathing rose from 18 to 23½. On coming out the pulse rose 8 in five minutes. With 1 per cent. the pulse fell 4 in the hour. The following results were obtained by breathing air with carbonic acid entirely free from organic matter, the inspirations being taken from a prepared reservoir, and the expirations not being allowed to mix with them:—

With 1 per cent. CO<sub>2</sub> a rise of 2, then a fall of 5 beats of the pulse in 26 minutes.  
 „ 0.5 pulse fell 5 in 40 minutes, respiration rose 7.  
 „ 0.25 carbonic acid pulse rose 3 and fell 4 in 30 minutes, respiration rose 4.  
 „ 0.1 carbonic acid rose 1 and fell 1 in 45 minutes, breathing rose 1.

Ordinary air was breathed in the same way, so as to eliminate the effect of the apparatus. Pulse rose 1 and fell 1, but no greater change occurred during a whole hour. Breathing continued unchanged except at one interval, when it fell 1 and then resumed its usual number. In no experiment during the whole period did the breathing of the same experimenter ever fall 1 when there was as much as 1/10th per cent. of carbonic acid present. In one person, a youth, the pulse rose on every trial. On entering into the air with 3 per cent. of carbonic acid and no organic matter, his pulse rose 6 in two minutes and his breathing fell 4. The pulse was so feeble that he could not count it; some one helped in the process. He found the air very unpleasant. Another young man in two minutes in the same air, found that his pulse rose 6 and his respirations 4. The action of carbonic acid seems therefore, in all cases to enfeeble the pulse; at first sometimes to cause a rise, but finally to lower the number of the beats. This effect is instantaneous or nearly so with air having 3 per cent. of carbonic acid, but diminishes with the amount of impurity. It is, however, perceptible with an amount of carbonic acid as low as 0.1 per cent, and probably by taking long periods the effect would be found even with smaller quantities. This amount is often exceeded in private houses and public meetings, where it rises to 0.2 or even 0.3. The second effect of carbonic acid is in the breathing, which it hastens rapidly, although in some cases it causes a diminution of the inspirations. The effect approaches either a gasping or a panting. The author added that he must leave to physiologists to speak of the ultimate effect of such a condition of things, and would only observe, that in Dr. Peacock's inquiries into the state of health of the Cornish miners, he found that a feeble pulse was one of the peculiarities, a proof that the temporary results found in these experiments may be rendered permanent. On coming into fresh air the pulse and breathing recovered in a few minutes, showing the value of ventilation.

ACADEMY OF SCIENCES.

February 6, 1865.

At the last sitting of the Academy the reports of the various commissioners were read, and announcement made of the prizes awarded. The Jecker prize was awarded to M. Wurtz for his last studies on the alcohols. The Lalande prize was adjudged to Mr. Carrington, of Redhill, for his "*Observations on the Solar Spots from the 9th of November, 1853, to the 24th of May, 1861.*"



## NOTICES OF BOOKS.

*On Acting and Kindred Subjects Considered in Relation to Genius and Talent. Also on Theories of Chemistry.*  
London: J. and F. C. Matthieson. 1865.

WE are always glad to meet with a chemist who is something more than a chemist; for a man of one science is as great a bore as the dreaded *homo unius libri*. We must confess, however, that we have read this little book with more pain than pleasure. We feel satisfied that the author will one day regret that he has printed it, and therefore it is a charity to hope for him that nobody will read it.

*Annales de Chimie et de Physique.* January, 1865.

THIS journal is, for the most part, made up of papers which have appeared at length or in abstract in the *Comptes-Rendus* of the Academy, and which have, therefore, been noticed already. The reader will find here at full length the valuable researches of MM. Bussy and Buignet "*On the Changes of Temperature produced by the Mixture of Liquors of Different Natures*;" also, the memoir of M. Dumour "*On Callais*," and that of M. Le Guen, "*On the Effects of Wolfram in Cast-Iron Guns*." Besides, there is an interesting memoir for electricians by M. Crova, "*On the Laws of the Variation of the Electromotive Force in Piles with one Liquid*." We also find an account of some "*Chemical Researches on Germination*," by M. Fleury. The object of the author's researches was to determine the part played by the fatty matters in seeds in which these matters accumulate; and those he experimented upon were castor and colza seeds, sweet almonds, and the seeds of *Euphorbia lathyris*. We cannot here notice his analytical methods, and now only refer to the general results. The author finds that the use of the fatty matters is not only to furnish respiratory matter during germination, but also to yield new materials which the plant requires for its growth. The first change of the fat is into sugar or dextrine, which then becomes organised into cellulose. This stage sometimes passes so rapidly that it is difficult to fix the preceding change. The oxygen of the air burns the excess of carbon and hydrogen in the fats to bring them to the composition of the carbohydrates—dextrine, sugar, and cellulose; and sometimes goes further, oxygen being fixed on the fatty matter. In fact, the author finds that a given weight of oily seeds always acquires oxygen in the course of germination. M. Fleury also shows that fat disappears more rapidly from germinating seeds than from the bodies of starving animals. He thought it unnecessary to look for any catalytic agent susceptible of causing the transformations, considering that the play of chemical affinities under vital influence was sufficient to account for the changes. M. Dupré continues his second memoir "*On the Mechanical Theory of Heat*."

*Journal de Pharmacie et de Chimie.* January, 1865.

THE *Journal* opens with a *resumé* of the proceedings of the Paris Pharmaceutical Society in 1864, by the Secretary of the Society, M. Buignet. It gives an excellent account of the principal discoveries in chemistry and pharmacy made in France during the past year, in which, however, we find nothing which has not been laid before our readers. We may say the same of the greater part of the contents of this number of the *Journal*; but in the medical review we find a notice of the "*Chemical, Physiological, and Therapeutic Properties of Iodoform*" by Dr. Righini, which seems to show that this body may be a valuable therapeutical agent; and for this reason we shall translate the paper. Another paper deserves a further notice—"On the Alkaloid of the Calabar Bean" by MM. Vée and Leven. The authors show that the phytostigmine of Jobst and Hesse is

a mixture of several bodies, including a crystallisable body, *ésérine*, which they regard as the true active principle. We give in another place the method of extracting this body.

*Chemisches Central-blatt*, Nos. 3 and 4. 1865.

IN noticing these journals we can only remark again that, with one exception, all the papers of interest have been already noticed in our pages. The exception is a paper by Dr. Lermer, "*On the Chemical Resistance of Lead and its Alloys with Tin to the Vapour of Water*." From the Doctor's experiments it appears that pure lead is strongly attacked by the vapour of water, but on the addition of tin the action rapidly decreases. With equal parts of lead and tin, the action is only about one-tenth of what takes place with pure lead. An alloy containing 37 per cent. of lead is scarcely at all attacked. The author also shows that pure tin does not altogether resist the vapour of water. These facts are of some importance to the manufacturers of distillatory apparatuses.

In No. 4 we find an account of the proximate constituents of the seeds of *Lolium temulentum*, by Ludwig and Strahl, in which, however, they do not seem to identify the poisonous principle. They remark the presence of four different fatty matters, and a bitter principle, soluble in ether and spirit, as well as the usual ingredients of the seeds of the Gramineæ. We find here, too, a short notice of "*A Method of Separating Quinine from Cinchonine Salts*," by R. Palm. The author adds a boiling solution of the two salts to a solution of pentasulphide of potassium. Cinchonine is thus separated as a white powder, mixed with sulphur; the quinine, on the contrary, separates as a white resinous mass, which becomes hard on cooling.

## NOTICES OF PATENTS.

1374. *Improvements in the Mode of Heating Animal, Vegetable, and Mineral Matters whereby to Effect their Desiccation, Vaporisation, Decomposition, Reduction, Fusion, &c.* W. CLARK, Chancery Lane, London. A Communication. Dated June 2, 1864.

FOR the purpose of conducting the distillation of all classes of substances included under the comprehensive definition set forth in the title, the patentee claims a mode of heating them in close vessels whereby the volatilised products given off are themselves made the medium or vehicle for the application of the necessary degree of heat to fresh portions of the substances under treatment. In a similar manner various processes of desiccation, fusion, reduction, and decomposition are intended to be carried out, with the object of obtaining superior products by the least possible consumption of fuel.

The principle of this invention seems to be very similar to, if not identical with, the system of using heated permanent gases, which was patented two days earlier by Mr. J. Young, of Bucklersbury, a notice of which appeared at page 71 of our last number.

1375. *Processes and Apparatus for Treating Alkaliferous Minerals to obtain Alkalies, Alkaline Salts, Alumina, and Accessory Products.* F. O. WARD, Hertford Street, Mayfair, London. Dated June 2, 1864.

IN order to liberate potash and soda from feldspars and other minerals containing these alkaline bases, and to procure at the same time alumina or its compounds, the inventor fuses such minerals with fluoride of calcium with or without the addition of lime, whereby soluble alkaline salts are produced.

The use of the same flux was patented by Mr. F. O. Ward on the day previously for the reduction and treatment of the very refractory ores of chromium, and this



appears to be but a modification of a former patent by the same gentleman.

1387. *Treating Petroleum and its Products.* B. AZULAY, Rotherhithe. Dated June 3, 1864.

For the disinfection of crude petroleum, the patentee employs an aqueous solution of chloride of lime, which is brought into more thorough contact with the oil by the employment of pumps and frequent agitation.

1390. *Purifying or Refining Oils.* F. TOLHAUSEN, Paris. A communication. Dated June 4, 1864. (Not proceeded with.)

IN the treatment of all kinds of raw oil the inventor proposes to mix them with nitric and sulphuric acids, and to add camphor and paraffine. The action is assisted by the employment of a moderate heat.

1401. *Separating certain Metals and Metallic Substances from Ores, &c.* J. NAPIER, Glasgow. Dated June 6, 1864.

THIS specification describes, in the first place, a mode of subliming metallic substances of a volatile nature by the application of heat, particularly that of superheated steam, hot air, or other suitable gas, to ores or crude mixtures containing such metals or metallic compounds. The second claim refers to the reduction of products obtained in the manner before mentioned, or of natural products containing metals, by submitting these substances to the action of heated gases, which are capable of combining with or other separating the associated element or elements.

1404. *Clearing Away and Removing Sand, Mud, or other similar Accumulations, from Dock and Canal Entrances, the Beds of Rivers, &c.* G. MEZOTTI, Upper Seymour Street, Euston Square. Dated June 6, 1864. (Not proceeded with.)

THIS proposal is directed to the removal of accumulations of sand or mud by the employment of force pumps, whereby a current of air or water is made to pass through hose or pipes to the immediate neighbourhood of the deposits, which are in this way caused to become suspended in the water, and then are easily got rid of by taking advantage of tidal currents or artificial expedients having a similar tendency.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

2876. A. G. Hunter, Rockcliff Hall, Flintshire, "Improvements in the manufacture of soda and potash."—Petition recorded Nov. 17, 1864.

56. B. W. Bentley, Buxton, Derbyshire, and W. H. Bailey, Salford, Lancashire, "Improvements in producing and finishing photographs and photographic transparencies on paper and other suitable substances, and in the machinery employed therein."—Jan. 7, 1865.

72. E. Pettitt, Birmingham, Warwickshire, "Improvements in giving permanence to and in ornamenting glass transparent positive photographs."—Jan. 10, 1865.

103. M. Henry, Fleet Street, London, "Improvements in furnaces."—A communication from D. Chrado, Turin.—Jan. 12, 1865.

110. W. S. Longridge, Alderwasley Iron Works, Derbyshire, and James Mash, Bowden, Cheshire, "Improvements in furnaces."—Jan. 13, 1865.

112. A. J. Sax, Paris, France, "Impregnating air for hygienic or therapeutic purposes with the vapours or emanations arising from tar, creosote, or other suitable liquid antiseptic or anti-putrid substances, or disseminating in the air for the said purposes suitable pulverised substances."—Jan. 13, 1865.

119. G. Davies, Serle Street, Lincoln's Inn, "A method of, and apparatus for, preventing incrustation or calcareous deposits in steam-boilers."—A communication from A. F. Porter, Philadelphia, U.S.A.—Jan. 16, 1865.

140. R. A. Brooman, Fleet Street, London, "Improvements in treating phosphates of lime and salts of potash and soda in order to fit them for agricultural uses."—A communication from G. Ville, Paris, France.—Jan. 17, 1865.

173. J. Hewes, West Bromwich, Staffordshire, "Improvements in puddling, heating, and other reverberatory furnaces used in the manufacture of iron and steel, and for other purposes, which improvements may also be applied to steam boiler furnaces."

176. B. F. Stevens, Henrietta Street, Covent Garden, Middlesex, "Improvements in vulcanising compounds and vulcanised fabrics."—A communication from S. Stevens, New York, U.S.A.—January 20, 1865.

194. E. Atkinson, Old Bond Street, Westminster, "An improved apparatus for containing and dispersing scents and other liquids."

201. A. M. Dietz, St. Paul's Buildings, London, "Improvements in petroleum and coal oil burners and glasses."

202. B. King, Ipswich, Suffolk, "Improvements in the manufacture of manure."—January 23, 1865.

206. J. Rovère and H. A. B. Huguet, Rue de Malte, Paris, France, "A new electric pile."

207. G. Haseltine, Southampton Buildings, Middlesex, "Improvements in the mode of, and means for preserving fruit and other eatables."—A communication from B. M. Nice, Indianapolis, Indiana, U.S.A.

209. W. Woodward, R. Woodward, J. Woodward, and A. Woodward, jun., New Islington, Manchester, Lancashire, "Improvements in furnaces for melting metals and smelting ores."—January 24, 1865.

226. A. A. Croll, Coleman Street, London, "Improvements in the purification of coal gas."

227. H. W. Ripley, Lightcliffe, near Halifax, Yorkshire, "Improvements in colouring kempy wool and hair."

229. J. G. Williams, St. Stephen's Crescent, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."—Jan. 26, 1865.

244. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of oils obtained from the distillation of tar, and in the application of the same to the purposes for which ordinary drying oils are applicable."—A communication from C. Cordier and V. Cordier, Paris, France.—Jan. 27, 1865.

246. G. Haseltine, Southampton Buildings, Middlesex, "An improved process of manufacturing syrup and sugar from maize starch, and other cereal grain starch."—A communication from F. W. Goessling, Buffalo, New York, U.S.A.

250. W. E. Newton, Chancery Lane, Middlesex, "Improvements in the rectification of alcohol, and in the apparatus to be employed therein."—A communication from A. A. Foubert, Rue St. Sebastien, Paris, France.

256. A. S. Macrae, Liverpool, Lancashire, "Improvements in lanterns for burning hydro-carbon fluids."—Jan. 28, 1865.

259. J. McInnes, Liverpool, Lancashire, "A metallic anti-corrosive varnish for protecting the surfaces of metals from oxidation."

261. W. Teall, Wakefield, and A. Naylor, Bradford, Yorkshire, "Improvements in means or apparatus for extracting or expressing oil or grease from the greasy waste of fibrous substances, or other substances containing oil or grease."—Jan. 30, 1865.

269. R. A. Brooman, Fleet Street, London, "Improvements in rail and tramways, in laying electric telegraph wires, and in compositions for coating the same."—A communication from J. A. E. Laloubère, Paris, France.

270. W. H. Cox, Bermondsey, Surrey, "Improvements in tanning hides and skins, and in apparatus employed therein."—Jan. 31, 1865.



## NOTICES TO PROCEED.

2329. T. and T. F. Walker, Birmingham, Warwickshire, "Improvements in means or apparatus for the utilisation of sewage matters, part of which improvements is applicable to raising and forcing other fluids."—Petition recorded Sept. 22, 1864.

2336. M. Henry, Fleet Street, London, "Improvements in dyeing and tanning, and in preparing for dyeing and printing."—A communication from F. V. A. Autier, Paris, France.—Sept. 23, 1864.

2387. T. J. Denne, Mile End, Middlesex, "An improved method of protecting the sides and bottoms of iron ships and other submerged iron structures."—Sept. 28, 1864.

2522. E. Moride, Nantes, France, "Improvements in the treatment of sea wrack grass for the extraction of the carbon and the salts contained therein."—Oct. 13, 1864.

2552. W. Clark, Chancery Lane, Middlesex, "Improvements in the preparation of artificial wax."—A communication from J. Montier and others, Boulevard St. Martin, Paris.—Oct. 15, 1864.

2428. R. A. Brooman, Fleet Street, London, "The manufacture of a substitute for albumen." A communication from C. Kestner, Thann, France.—Oct. 3, 1864.

2487. J. Cassell, La Belle Sauvage-yard, London, "Improvements in treating coal, peat, shale, wood, and ligneous products, and in obtaining fuel, oil, and other products therefrom."—Oct. 10, 1864.

2634. W. Clark, Chancery Lane, Middlesex, "Improvements in apparatus for concentrating and distilling sulphuric and other acids, and all solutions in general." A communication from E. A. Cotelte, Boulevard St. Martin, Paris.

2635. G. T. Bousfield, Brixton, Surrey, "Improvements in manufacturing aerated bread by the application of carbonic acid gas obtained from fermenting vegetable matters, and in the apparatus employed therein." A communication from S. T. Bacon, Boston, U. S. A.—Oct. 24, 1864.

3045. E. T. Hughes, Chancery Lane, London, "Improvements in treating aniline colours for dyeing and printing." A communication from A. S. L. Leonhardt, Berlin, Prussia.—Dec. 17, 1864.

3093. C. Hancock, West Street, Smithfield, and S. W. Silver, Bishopsgate Street, London, "Improvements in colour printing."—Dec. 14, 1864.

3184. R. L. Howard, Upper Whitecross Street, Middlesex, and John Daughlish, Reading, Berkshire, M.D., "Improvements in apparatus for making aerated bread."—December 22, 1864.

3215. W. E. Gedge, Wellington Street, Middlesex, "An improved apparatus for administering douches and injections with continuous and continual jet."—A communication from J. Salamon, Faubourg St. Martin, Paris, France.—Dec. 27, 1864.

3229. J. D. Morrison, Weary's Place, Edinburgh, N.B., "Improvements in painless dentistry by apparatus for cooling and tempering air and applying it as an anæsthetic agent."—Dec. 29, 1864.

## CORRESPONDENCE.

## Continental Science.

PARIS, February 14.

THE Academy of Sciences has awarded the Lalande medal, the highest astronomical prize in the gift of the Academy, to Mr. Richard Carrington, of Redhill, the indefatigable observer of solar spots. I mention this with pleasure, for among the members of the Academy it must be admitted that there are some manifestly afflicted with Anglophobia.

Among the many improvements in photographic apparatus one of the most important is that made recently by

M. Dubroni. He has contrived a most complete set of apparatus which a photographer on his travels can almost put in his pocket, and by means of which ladies can practise the art without risk of soiling their fingers. His camera is a small box of yellow glass, and within this all the operations which it is necessary to perform beyond the reach of actinic light are effected by the use of very simple contrivances. After the collodion has been applied to the plate, it is fixed in its place in the camera, and the sensitizing solution is conveyed to it by means of a glass pipette furnished with an india-rubber bulb. When a good coating is obtained, the excess of nitrate of silver is sucked up by the same pipette, and returned to the bottle. After exposure the developing solution is conveyed to the plate in the same way with another pipette. To avoid mistakes, M. Dubroni makes the pipette for applying the nitrate of silver of blue glass and that for the developer of red glass. The fixing and washing are, of course, carried on outside the camera. The only difficulty I see is in preventing the access of light by the opening in the top of the camera through which the pipettes are passed down to the plates: the inventor, however, seems to have avoided this. You will no doubt have the apparatus in London soon, so I need not describe it more particularly.

A little medical news will have some interest, or at all events some amusement, for your readers. An old *pathy* is just now being revived in Paris. *Metallopathy* was much practised here five-and-twenty years ago, but has been almost forgotten, although occasionally referred to by great names. It means the cure of nervous affections by the application of metallic plates to the seat of pain. Besides the immediate relief of pain, other wonderful effects are reported to follow the application of the metal, but I need only mention the former most important result. The reviver of the practice is Dr. Dufraigne, who relates the following extraordinary cure:—He had invited a dinner party, and among the guests was a lady, who, just as the company were about to sit down, was seized with a violent headache. A happy thought struck the doctor. He sent for the cook, who came with a copper stewpan, which the doctor held to the lady's forehead for ten minutes, after which she was perfectly cured, and sat down to her dinner as lively as the rest. A second attack at home some days later was cured in the same simple way.

The relative advantage of ether and chloroform as anæsthetics is now being again discussed. In Naples, ether is preferred, and it is used in a peculiar way. Some of the fluid is poured upon rags in a bag or bladder, and from this the patient takes large and frequent inspirations. Insensibility very soon ensues, and is attended, it is said, with no danger, although the ether vapour is inhaled almost without air. In Paris, also, it seems to be believed that the use of chemically-pure ether is quite free from all danger, which is more than can be said for chloroform.

Some of the works on experimental physiology and medicine which have been rewarded by the Academy of Sciences will be found well worthy the attention of physiologists and medical men, particularly that of M. Sappey "On the Structure of the Ovary," and M. Zenker "On the Trichina Disease."

## The Sugar of the Future.

To the Editor of the CHEMICAL NEWS.

SIR,—Dr. Adriani, in translating Dr. de Vry's note to him, renders Indian cane *Canna indica*, a starch-producing plant, but certainly not one of the plants cultivated for sugar; it should be the *Beta vulgaris* and *Saccharum officinarum*. I fear Dr. de Vry has scarcely looked into the statistics of sugar consumption in Europe and America, or he would find that thousands of acres planted with the Arenga palm would go but a very small way towards sup-



plying one tithe of the quantity required annually. All the palm-sugar that could be produced in India and the East would find a ready local consumption. Another error Dr. de Vry falls into is, that land employed for the production of the sugar-cane in the tropics ought to be applied to the culture of rice. Does he not know that rice is a semi-aquatic plant, the quantity of hill or upland rice grown being very small, whilst the sugar-cane luxuriates in a deep rich loam or clayey soil?—I am, &c.

P. L. SIMMONDS.

*The Jury Reports.*

To the Editor of the CHEMICAL NEWS.

SIR,—An error in my letter on the subject of the Jury Reports of the Exhibition of 1862 has led your correspondent, "A Chemist," into making a charge against the Society of Arts which has no foundation in fact. Messrs. Bell and Daldy, the publishers of the Reports, inform me that each and every Report was on sale separately to the public.—I am, &c.

P. LE NEVE FOSTER.

Society of Arts, Manufactures, and Commerce, John Street, Adelphi, London, W.C., February 8.

[In reply to the above, we must state that we ourselves sent repeatedly to Messrs. Bell and Daldy for the Report on Class II., Section A., and at last, when we knew it was in circulation, were, as we thought, distinctly informed that there were none for sale separately.—ED. C. N.]

*Production of Ammonia.*

To the Editor of the CHEMICAL NEWS.

SIR,—In your impression of January 20 you transcribe a notice of some experiments by M. Dechame on the production of ammonia by the action of "arable soil" upon atmospheric air. Now, this is a subject which I have most attentively studied (although not without frequent intermissions) for several years past, and so interesting have been my results that I hope to publish them in detail next season, if not during the present one.

I have produced ammonia in no (comparatively speaking) inconsiderable quantity, under various circumstances, directly from air and water by the interposition of certain earths, soils, and marls, at varying temperatures. But, as whenever a "vegetable earth" or "soil" of any kind is employed the result cannot be depended upon as rigidly and analytically correct, however carefully the experiments may have been conducted, I have also followed another plan.

De-ammoniated air (I use the term for the sake of brevity), when passed over small nodules of pumice-stone about 0.1 to 0.2 inch in diameter, and moistened with either pure water or dilute solutions of certain salts, always gave me, with proper precaution, evidences of the formation of ammonia. Sometimes peroxide of hydrogen is also produced. When the prepared pumice-stone is moistened with a very dilute solution of pure neutral chloride of sodium the formation of ammonia is materially accelerated, and other substances modify the results in different ways.

It would be useless at the present moment to occupy more of your space by going deeper into the subject, but I may ask you for "a few columns" hereafter.

In the same number of your journal I also notice a self-registering maximum thermometer,\* and from the *Comptes Rendus* an account of a thermometrical fire alarum.†

Without wishing in the slightest degree to detract from the merits of Mr. Twining's sounding apparatus, I may observe that his thermometer is identical in principle and construction with an experimental one of my own, which

some years ago I fully tested and condemned as utterly untrustworthy for sounding purposes. Spirit thermometers in every form were objected to by the Society of Arts' committee appointed to investigate the matter, and the society's silver medal was awarded to me in 1858 for my "compensation" mercurial maximum thermometer, an illustrated description of which has already appeared in these pages. Up to the present time there has appeared, I believe, no other instrument of such definite accuracy, whether in a state of repose or violently agitated, no moveable indices whatever being employed in my thermometer.

By modifying the construction slightly, I have produced an "electro-thermometrical alarum"—which, owing to the loss of some papers, &c., through the post, was not exhibited at the last meeting of the British Association—capable of being "set" so that any specific rise or fall of temperature, from 0.1° to 300° or 400°, will cause the alarum to act; thus the instrument can be employed for a green-house one day, for a boiler the next, and for a delicate chemical or physiological experiment on the following with equal accuracy and facility. It will be exhibited shortly.

I am, &c.

WENTWORTH L. SCOTT, F.C.S., &c.

Westbourne-park.

*Combustion in Carbonic Acid.*

To the Editor of the CHEMICAL NEWS.

SIR,—I am not sure that the subjoined experiment is important or new, but I have not found it recorded, and it seems a suitable illustration for the lecture table.

It is known that heated potassium will decompose carbonic anhydride, burning in the gas with extrication of carbon  $\text{CO}_2 + \text{K}_4 = \text{C} + 2 \text{K}_2\text{O}$ .

I find that ignited magnesium wire will similarly burn with some brilliance in  $\text{CO}_2$ , but without the liberation of any carbon; the reaction is probably, therefore, a less complete deoxidation— $\text{CO}_2 + \text{Mg} = \text{CO} + \text{MgO}$ . The solid results of the combustion are magnesia and carbonate of magnesia, and the resulting gas contains CO, as determinable by cuprous chloride.

The experiment is eminently contradictory of popular and preconceived notions respecting combustibles and supporters of combustion, for herein a metal burns in a gas which is neither combustible nor a supporter of combustion, and produces a combustible gas.

The similar actions of iron and zinc upon  $\text{CO}_2$  are mentioned in text-books, but are less easily capable of demonstration.

I am, &c.

B. W. GIBSON, F.C.S.

February 13.

MISCELLANEOUS.

**Pharmaceutical Society.**—The next Pharmaceutical meeting will be held on Wednesday, March 1, when Dr. Redwood will read a paper "On the Preparation of Nitrous Ether and Sweet Spirit of Nitre."

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday and Thursday, February 21 and 23, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Friday, February 24, at 8 o'clock, John Evans, Esq., F.R.S., "On the Forgery of Antiquities."

**Beef at Threepence per Pound.**—On Tuesday last we attended at the London Tavern, and made trial of various dishes prepared from the beef imported by the South American Beef Company. Of the soups we may speak in the highest praise, and the curries were not to be despised. The *bouilli*, the least satisfactory of the dishes, was scarcely inferior to what we have eaten at continental *tables d'hôte*. We hope this entertainment will

Mr. F. Twining "On Appliances for Taking Deep Soundings."

† "Thermometer Alarum," page 35.



serve to dissipate all the doubts which various people have held as to the possibility of making the beef palatable as well as nutritious. It simply requires time and care in cooking. We must add that the Company now supply the beef in powder, or ground with peas, so that strong, highly nutritious soups can be prepared without the trouble of long boiling.

**Chlorodyne.**—The following recipe will furnish a preparation having the pharmaceutical properties of chlorodyne, according to Dr. Ogden:—R. Muriate of morphia, grs. viii.; water, fl. 3ss.; perchloric acid (25° B.), gtt. xx.; chloroform, fl. 5jss.; tinct. of Indian hemp, fl. 5j.; hydrocyanic acid (U. S. P.), gtt. xii.; molasses, fl. 3ss.; oil of peppermint, gtt. ij.; oleoresin of capsicum, gtt. i. To the morphia and water in a small flask, add the perchloric acid, and heat until a clear solution is obtained; then add the molasses, previously warmed to render it fluid. Heat the mixture, and agitate well. When cold, add the other ingredients, and mix thoroughly.—*American Journal of Pharmacy*.

**Test for Rum.**—Dr. Wiederbold proposes the following method for distinguishing between true rum and the factitious liquids sold under this name:—Mix a little of the rum to be tested with about a third of its bulk of sulphuric acid, and allow the mixture to stand. If the rum is genuine its peculiar odour remains after the liquid has cooled, and even after twenty-four hours' contact may still be distinguished. If, on the contrary, the rum is not genuine, contact with sulphuric acid promptly and entirely deprives it of all its aroma. The author affirms that he had never found this very simple process fail, and that all spurious rums may thus easily be distinguished from the genuine.—*Report de Pharmacie*.

**Report on the Patent Laws.**—The following are the recommendations with which the commissioners sum up their investigation into this important subject:—  
"1. Your commissioners do not find that the present cost of obtaining letters patent is excessive, or the method of payment inconvenient. They do not, therefore, recommend any alteration of the present system on those points; but they think that patent fees should not be made to contribute to the general expenditure of the State until every reasonable requirement of the Patent Office has been satisfied. 2. They are unable to recommend a preliminary investigation into the merits of the invention for which a patent is claimed; but they advise that a careful inquiry be instituted, under the direction of the law officers of the Crown, as to whether there has been any previous documentary publication of the intention, either by grant of letters patent or otherwise; and if such publication have taken place, that the patent shall be refused. No evidence other than such documentary evidence should be admissible, and the reasons for the refusal to grant the patent should be certified by the law officers; an appeal from their decision should lie to the Lord Chancellor. 3. Your commissioners are of opinion that the present mode of trying the validity of patents is not conducted in a satisfactory manner. That such trials ought to take place before a judge sitting with the aid of scientific assessors, but without a jury, unless at the desire of both parties to the suit or action. That such assessors ought to be selected by the judge in each case, and the remuneration to be paid them be included in the costs of the suit or action, and provided for in such manner as the judge shall direct. That no special judge be appointed for the trial of patent cases, but the judges of law and equity be empowered to make rules by which one court should sit for trial of patent cases exclusively. That on such trial the judge, if sitting without a jury, decide questions of fact as well as of law. 4. That the granting of licenses to use patented inventions ought not to be made compulsory. 5. That patents ought not to be granted to importers of foreign inventions, 6. That

in no case ought the term for which a patent is granted to be extended beyond the original period of 14 years. 7. That in all patents hereafter to be granted a proviso shall be inserted to the effect that the Crown shall have the power to use any invention therein patented without previous licence or consent of the patentee, subject to payment of a sum to be fixed by the Treasury. 8. While, in the judgment of the commissioners, the changes above suggested will do something to mitigate the inconveniences now generally complained of by the public as incident to the working of the patent law, it is their opinion that these inconveniences cannot be wholly removed. They are in their belief inherent in the nature of a patent law, and must be considered as the price which the public consents to pay for the existence of such a law. Two of the commissioners, Mr. Hindmarsh and Dr. Fairbairn, do not concur with all these recommendations. Both these gentlemen think that under some circumstances the patent should be extended beyond the original fourteen years. Mr. Hindmarsh further recommends that no patent should be granted for an invention until a specification of it, containing a clear and distinct statement of the claim or claims made by the inventor, has been filed in the Patent Office, and that the sufficiency of all claims in specifications should be ascertained and certified by competent persons appointed to perform that duty. He also recommends that a petitioner should have the right of appeal if a patent be refused by the law officer.

**Queen Mary on the Sale of Poisons.**—The recent letter of the Queen to the directors of railway companies recalls to our mind the letter of another Queen—Mary of evil memory—to the College of Physicians, requesting them to carry out more efficiently the Act 32 Henry viii., c. 40, and also to "call and convent" before them "the Wardens of the Grocers and al the Apothecaries," and "streightly to charge and commande by authoritie that from tyme to tyme hensforthe neither thei nor anye of them do entrepryce to sell or retayle any such wares, drugge or druggs as hath in theim any spice of venome or suspicion of poyson, or such other as by receivying of them at the handes of anie unlerned or of anie malitiose or evyll disposed persons maie by anie means grievously hurte or put in perille or daunger of lief anie of our Subjectes of what estate or degre soever he or thei be, Onlesse the seller of any of the said druggs be well assured of the honestie, true dealying and good intent and skill of the byar; And first examyn the same for what intent or purpose he buyeth the same, and therewithal to note the name of the byar and time of the buying; Or else that the said grocer or apothecarie have with him remaining the handwriting of some discrete, lerned and authorised Physician for his discharge. Willing and streightly comandying the said grocers and apothecaries and every one of them not to faile herof as thei tendre our pleasure &c &c. Given under our Signet at our Manor of St. James the xxiii daye of June in the fourthe and fivethe years of our reignes" (1557). The above appears to be the first suggestion of a Poison Act in England.

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

Mr. C. N. Ellis suggests that animals might be slaughtered by means of a violent shock of electricity.

T. W.—The errors are in the originals.

Pharmakon.—We know of no mechanical means of separating the gases.

F. W. P.—We have never met with the article.

Studiosus.—Boil the solution, and the sulphur will collect in a mass.

C.—By means of proto-nitrate of palladium.

Received.—Dr. Adriani, "On Cotton-seed Oil," Shall appear next week



## THE PATENT LAWS.

THE summary we published in our last number will have informed our readers of the alterations that the Commissioners appointed two years ago to investigate the subject, recommend to be made in our Patent Laws. These alterations are not many, but some are of considerable importance. With regard to the cost of obtaining a patent, the Commissioners appear to consider no change necessary. Many will be dissatisfied with this decision; the fees at present exacted are an insuperable barrier to the poor inventor; but higher charges might, perhaps, deter the crowd of speculators whose patents are the greatest sources of annoyance and perplexity alike to manufacturers and real originators. A suggestion as to the application of the fees deserves the highest commendation. The Commissioners recommend that no part of them should be contributed to the general expenditure of the State until all the requirements of the Patent-office, library, and museum, are fully satisfied. At present the surplus is about 40,000*l.* per annum; a fact which makes the establishment in Chancery-lane appear perfectly disgraceful to the Government. We shall say no more on this point at present, but at some future time we may point out several ways in which some of this surplus may be expended to the credit of the Government, and the better information of the people.

The Commissioners do not recommend that any preliminary investigation should be made into the *merits* of a patent, but they do advise that a careful inquiry should be instituted as to whether there has been any previous documentary publication of the invention, either by letters patent or otherwise; in other words, they recommend that the novelty of an invention should be strictly inquired into. We must confess ourselves a little puzzled by the words "documentary or otherwise." A book or journal, we imagine, is not a document in a legal sense; and if only documentary evidence is to be admitted, we fear it will still be open to an enterprising man to patent some specific application of a general process which has been described in a dozen journals or books, and to which in reality he has not the smallest claim.

The most radical alteration proposed is in the mode of trying the validity of patents. The Commissioners (a majority of them lawyers) have conceded that in these actions the judge should be assisted by scientific assessors. The need of this has been made evident many times. It is no disgrace to a profound lawyer that he is not at the same time an accomplished chemist or a well-informed engineer, and it is placing a man in an utterly false position to require him to decide on questions he cannot fully understand. We can, indeed, imagine it painful to listen to the rambling judgment or summing up of an upright-minded man, severely bent on doing justice, who meanders through the scientific evidence, making snatches here and there for the real points at issue, which seem to dance about in the foggy atmosphere around him like will-o'-the-wisps, continually eluding his grasp, and to find him at last guided to his decision rather by some instinctive sense of right than by any clear insight into the matters in dispute; or, perhaps, resting upon some small technical point which saves him the trouble of going further after the broader issues. But then comes the question of the assessor, for a scientific jury is out of the question when every man of eminence may be subpoenaed on one side or the other. On this point we must be silent. "Sufficient for the day is the evil thereof."

Of the other alterations proposed by the Commissioners we need not speak; but a few words must be said in approval of a suggestion made by Mr. Hindmarsh. This gentleman has, perhaps, had more experience in patent cases than any other member of the bar, and what he says on the subject deserves attention. He recommends that a complete specification should always be filed with the petition. Of the propriety of this there can be no doubt. Every one will remember instances in which a painstaking inventor has carefully worked out his invention, and when he has completed his work has discovered that some one else has been to the Patent Office before him with a crude specification which effectually deprived him of the fruits of his labours. An idea may occur to many men at the same moment; but that man should be rewarded whose ingenuity and industry first reduce the idea to practice.

In conclusion we may quote the final words of the Commissioners:—"While," they say, "in the judgment of the Commissioners, the changes suggested will do something to mitigate the inconveniences now generally complained of by the public as incident to the working of the patent law, it is their opinion that these inconveniences cannot be wholly removed. They are in their belief inherent in the nature of a patent law, and must be considered as the price which the public consents to pay for the existence of such a law."

This is no doubt true. There must be inconveniences; but it should be the object of the Legislature to *minimise* (to use the expression of Jeremy Bentham) these inconveniences to the smallest possible point. The object of a patent law is simple enough. It is to ensure a reward to an inventor. Let the Legislature, then, take care, as far as it is possible, that only an inventor is rewarded.

## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

### PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(Continued from page 73.)

**Law of Gay-Lussac. — Difference between Atoms and Equivalents.**—In the early part of this century most chemists recognised the fact both of definite proportions and of multiple proportions. Some stopped there, and by preference used the terms *equivalents* or *proportional numbers*; whilst others, advocates of Dalton's theory, assumed that the proportional numbers represented the relative weights of the atoms, and called them *atomic weights*. But the terms equivalents and atomic weights had then the same meaning: they represented the same proportions. According to Dalton, as seen by the table just given, water was composed of one atom of hydrogen (1) and one atom of oxygen (7), whilst according to Wollaston it was formed of one equivalent of hydrogen and one equivalent of oxygen.

In reality the two words meant one and the same thing: the true atomic theory was not yet conceived.

And yet in Wollaston's time the facts had already been discovered which should have led chemists to separate these two ideas one from the other. In 1808 Gay-



Lussac propounded his memorable laws of the combination of gases by volume. After having found in 1805, with A. de Humboldt, that hydrogen and oxygen would combine in the exact proportion of two volumes of the first gas to one volume of the second, he generalised from these observations, and showed that there exists a simple relation not only between the volumes of two gases which combine, but also between the sum of the volumes of gas which enter into combination and the volume which this combination occupies when in the gaseous state. Thus:—

I. Two volumes of hydrogen combine with one volume of oxygen to form two volumes of aqueous vapour.

II. Two volumes of nitrogen combine with one volume of oxygen to form two volumes of protoxide of nitrogen.

It is seen in these two cases that the three volumes of combining gas are reduced to two volumes by the act of combination. There is a condensation of one-third. In ammonia there is a condensation to half the original volume; on the contrary, in the case of binoxide of nitrogen and of hydrochloric acid equal volumes of the two gases combine without condensation. Thus:—

III. Three volumes of hydrogen are combined with one volume of nitrogen in two volumes of ammoniacal gas.

IV. One volume of nitrogen is united with one volume of oxygen in two volumes of binoxide of nitrogen.

V. One volume of hydrogen is united with one volume of chlorine in two volumes of hydrochloric acid gas.

The discovery of Gay-Lussac was of immense importance. In the first place it gave a striking confirmation to the law of definite proportions, which was thus demonstrated, not only in reference to weights, but also to volumes: and it must be remembered that an independent proof was by no means superfluous, for the law to which it referred had even at this period some opponents. Berthollet took great pains to demonstrate even in 1808 that the proportions according to which bodies combine are not absolutely invariable. But even his great authority was of no avail against the power of facts. The opposite theory was victoriously upheld by Proust.

But there is another consequence of the discovery of Gay-Lussac. If we can admit with Dalton that the definite proportions according to which bodies combine represent the weights of their atoms, and if we are to agree with Gay-Lussac that the volumes according to which gases unite bear to each other simple and invariable proportions, it is clear that the relative weights of these volumes—that is to say, their densities—ought to represent the relative weights of the atoms. Thus, the atomic weights of gases ought to be proportional to their densities (or should at least bear a simple proportion to them). It therefore follows that to find the relative atomic weights of simple gases it is sufficient to determine and compare their densities. This is an immediate consequence of Gay-Lussac's law, and it is important from two points of view—first, in giving a new means for the determination or control of atomic weights, and then in leading chemists to realise a distinction between the notion of atomic weights and of equivalents. Hitherto they had been confounded, but henceforth a similar confusion was not possible. This is an important point, and it must, therefore, be clearly explained.

We have seen that Dalton, taking the atomic weight of hydrogen as unity, adopted for that of oxygen the figure 7 (the exact figure is 8); and that he looked upon water as formed of one atom of hydrogen and one atom of oxygen. But as hydrogen combines with oxygen in

the proportion of two volumes to one volume, if it is admitted that the atomic weights are in proportion to the densities, it must also be admitted that combination takes place in the proportion of two atoms to one atom. In fact, the densities of hydrogen and oxygen are in the ratio of 1 to 16, and not as 1 to 8, as would be required by Dalton's atomistic hypothesis of the composition of water. If, then, 1 is the atomic weight of hydrogen, that of oxygen will be 16; and since the combination of the two bodies takes place in the proportion of 1 to 8, or of 2 to 16, it evidently follows that water is composed of two atoms of hydrogen and one atom of oxygen. This is an inevitable consequence if we allow a proportionality between atomic weights and densities.

In respect to simple gases chemists have been led to admit this proportion, and to regard their volumes as representing atoms, and this conclusion has been strengthened by considerations drawn from the physical properties of gases. When examined at a moderate distance from their liquifying point, they dilate or compress in appreciably the same manner under the influence of the same variations of temperature and pressure.

It has therefore been admitted, Ampere being the first,\* that equal volumes of two gases contain the same number of atoms, and that consequently the atomic weights of simple gases are proportional to their densities.

Thus, the discoveries of Gay-Lussac became one of the fundamental bases of the atomic theory. In regard to this, Berzelius wrote as follows†:—"If we say atom instead of volume, and if we view bodies in the solid state instead of taking them in the gaseous state, we find in Gay-Lussac's discovery one of the most direct arguments in favour of Dalton's hypothesis."

It is a remarkable fact, that this latter philosopher opposed in principle Gay-Lussac's ideas; this singular opposition may be explained if we remember that Dalton had stated that when two bodies form only one combination, this is effected atom by atom. The law of volumes upset this hypothesis, which, moreover, rested on no solid foundation. This law was soon admitted by all chemists; and among those who used it largely in the development of the atomic theory, Berzelius stands first.

(To be continued.)

#### *New Process for Determining the Acetic Richness of Vinegar,† by M. JAILLARD.*

NUMEROUS processes have been proposed for determining the amount of real acetic acid in vinegar. They may be divided into physical and chemical processes. The first are founded on the use of acetimeters or vinegar weighers, but as vinegars contain variable quantities of water, acetic acid, salts, extractive matter, colouring matter, and sometimes even foreign substances added to them, it will be understood that instruments founded on the density of the vinegars may be liable to error.

The determination by weighing has been unsuccessfully attempted by several clever chemists, it requiring much care and much time. Volumetric methods, so simple and so easy, have been adopted by a great many authors; carbonate of potash has been employed by Soubeiran, ammonia by Ure, saccharate of lime by MM. Greville and Violette, carbonate of soda by M. Chevallier, and finally baborate of soda by M. Reveil. But all these pro-

\* The same idea was expressed by the Italian chemist, Avogadro.

† "Traité de Chimie," French edition, 1831, iv., 5, 32.

‡ "Mémoires de Médecine et de Pharmacie Militaires."



cesses have been applied directly, without taking certain difficulties into account, especially the presence of organic matters, which prevent the acetic acid from giving clear reactions with alkalis indicating the moment of saturation. The characteristic tint was looked for in vain, and but very uncertain results were obtained. Instead of modifying the mode of operation, one base was replaced by another, but without any real advantage. The volumetric determination presents also a radical difficulty; it does not indicate the term of the saturation by an abrupt change of tint as is the case with other acidimetric assays.

M. Jaillard's process consists in indirect volumetric estimation, and requires no unusual instrument or reagent. A graduated burette, a pipette holding ten cubic centimetres, a beaker and a stirring rod, some tincture of litmus, a normal potassic solution of about one tenth, and a certain quantity of Gay-Lussac's normal sulphuric acid, are the only instruments and reagents required. The operation is divided into two parts, the determination of the standard of the alkaline solution and the determination of the standard of the vinegar.

**Titration of the Alkaline Solution.**—Introduce 20 cubic centimetres into the beaker, add 100 cubic centimetres of water, and 6 drops of tincture of litmus, then with the graduated burette ascertain the number of cubic centimetres of Gay-Lussac's liquid necessary to saturate them.

**Acidity of Vinegar.**—Place, as above, 20 cubic centimetres of the alkaline solution in the beaker, dilute them with 190 cubic centimetres of water, and colour with 6 drops of tincture of litmus; add 10 cubic centimetres of the vinegar to be assayed, a quantity insufficient to neutralise the potassic liquid, and with the graduated burette finish the saturation with Gay-Lussac's normal sulphuric acid. The reaction is perfect when a single drop of acid liquid suffices to alter the colour. If, to effect the saturation, only 12 cubic centimetres of normal acid have been required, the difference between the quantities of acid used in the two portions of the operation evidently gives the amount of acetic acid required.

This difference,  $19.5 - 12 = 7.5$ , gives the amount, in weight, of monohydrated acetic acid in 100 parts of vinegar analysed by means of a simple proportion in which it is one of the given terms, and of which the others are represented by the equivalents of monohydrated sulphuric and acetic acids—

$612.50 : 750 :: 7.5 : x$ — $x = 9.18$  per cent. of monohydrated acetic acid.

This calculation may, moreover, be avoided by referring to the following table, in which is given the acetic richness of the vinegar facing the number of cubic centimetres of normal acid, representing the differences found :—

	Acetic richness.		Acetic richness.
1	1.22	9	11.01
2	2.44	10	12.24
3	3.67	11	13.46
4	4.89	12	14.68
5	6.11	13	15.91
6	7.34	14	17.13
7	8.57	15	18.35
8	9.79		

The results given by this process are as exact as possible, provided it be previously ascertained that the vinegar contains no other acid except acetic acid. It does, however, contain tartaric, succinic acids, &c., but in proportions so small as to render it unnecessary, in practical assays, to correct the data of the analysis.

## TECHNICAL CHEMISTRY.

*The Purification of Sulphate of Zinc,\**  
by M. le Dr. VAN DEN CORPUT.

THE processes used in Germany for purifying sulphate of zinc differ from those used in Belgium and France. All, though varying in the *modus faciendi*, are founded on the peroxidation of the ferrous, manganous oxides, &c., &c.; and on the precipitation of these per-oxides by means of hydrated oxide or carbonate of zinc.

As most metallic oxides of the third group are displaced by oxide of zinc, only in their highest state of oxidation, we begin by peroxidising these bases by passing a current of chlorine into the diluted liquid, until the solution, after having been shaken, decolorises litmus paper; then, after having separately precipitated about  $\frac{1}{10}$ th of this solution by carbonate of soda or by a little caustic potash, we collect on a filter the precipitate of carbonate or oxide of zinc thus produced, and wash it to get rid of the sodic carbonate it invariably takes with it.

The gelatinous substance collected on a filter is mixed, cold, with the rest of the solution, and then boiled for a few minutes.

Gmelin has proposed a modification of this method; it consists in precipitating directly part of the solution by carbonate of soda, mixing the precipitate, after washing, with the rest of the liquid, and then passing the gaseous chlorine through the mixture, which must be shaken until the greater part of the basic carbonate of zinc is dissolved and the liquid has assumed an opaque brown colour, owing to the precipitation of ferric, manganic, cobaltic, and niccolic oxides in the state of hydrates. The liquid having been first shaken and then boiled, the foreign oxides are allowed to deposit themselves, then the clear liquids are decanted and filtered, which, necessarily containing basic sulphate of zinc, must be acidulated by a little sulphuric acid before being crystallised.

By evaporating this acid solution of sulphate of zinc to the point of crystallisation, a salt is obtained, by means of which may be prepared, by the wet way, a brilliantly white basic carbonate of zinc.

The sulphate of zinc obtained in this way is not perfectly pure, for in consequence of the introduction of chlorine, which, by contact with carbonate or hydrate of zinc, forms chloride of zinc, it is difficult entirely to free this salt from crystals of sulphate of zinc—at least, without taking the precaution of adding a little sulphuric acid to the mother liquors.

A diluted solution must be used for this operation, for, as Schindler has remarked, a concentrated solution of sulphate of zinc absorbs chlorine with great difficulty.

**Death of Dr. Ulrich.**—We are sorry to have to announce the death, after a short illness, of this promising chemist, who was well known and highly esteemed by a numerous circle of scientific friends in London.

**Pulverisation of Phosphorus.**—Blondlot has found that phosphorus may be reduced to a very fine powder by melting it in a hot concentrated solution of any neutral salt, or even of syrup, and shaking continually until cold. It has long been known that phosphorus was brought to a finer powder in urine than in water, and that effect was ascribed to the presence of urea. M. Blondlot shows that it is merely a consequence of the density of the liquid.



## PROCEEDINGS OF SOCIETIES.

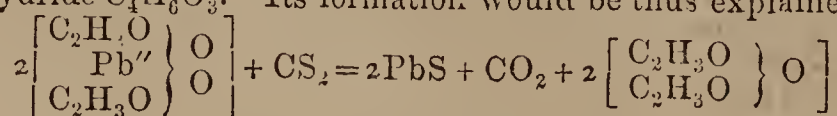
## CHEMICAL SOCIETY.

Thursday, February 16.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,  
in the Chair.

THE SECRETARY read the minutes of the last ordinary meeting, which, by the special invitation of Dr. Hofmann, was held in the Lecture Theatre of the Royal College of Chemistry. The several donations to the library were announced, and the names of the following candidates read for the first and second times respectively, viz.:—Dr. William Johnson, F.R.S., Newcastle-upon-Tyne, and Mr. George Jones, 106, Leadenhall Street. The Secretary then read a resolution passed at the last meeting of the Council, having reference to the election of officers for the year ensuing; it was thus worded:—"Resolved,—That the following officers and other members of the Council be recommended for election at the ensuing anniversary meeting of the members of the Chemical Society, in accordance with the bye-laws:—*As President*: Dr. W. A. Miller, in place of Dr. Williamson, who retires. *As Vice-President*: Mr. Warren De la Rue, in place of Mr. Alfred Smee. *As Treasurer*: Dr. Theophilus Redwood, in place of Mr. W. De la Rue. *As Secretary*: Mr. Augustus Vernon Harcourt, in place of Dr. T. Redwood. *As non-resident Member of Council*: Mr. G. C. Foster, in place of Dr. Andrews. *As resident Members of Council*: Mr. Duppa, Mr. Hadow, Mr. G. B. Buckton, in place of Dr. Mattheissen, Mr. Nicholson, Mr. J. T. Way."

A paper was read by Mr. JOHN BROUGHTON, B.Sc., entitled "*On a New Reaction for the Production of Anhydrides and Ethers.*" The author commenced by reviewing the methods employed for the preparation of the anhydrides of the monobasic organic acids, describing particularly the processes of Gerhardt and of Gal, and mentioned an unsuccessful attempt to procure acetic and benzoic anhydrides by the action of boracic acid upon the potassium salts of these acids. It then occurred to him to try the effect of bisulphide of carbon, which Frémy had shown to be readily decomposed by heated metallic oxides, with formation of carbonic anhydride and a metallic sulphide, and at a high temperature even by water, with production of sulphuretted hydrogen and carbonic anhydride. It was therefore thought probable that by acting on the dry metallic salts of the organic acids with bisulphide of carbon, the metal would be converted into sulphide and the anhydride set free. This opinion has been completely confirmed by the result of experiment. The author succeeded in forming acetic anhydride by heating together in sealed glass tubes acetate of lead, perfectly dried and finely pulverised, with a sufficient quantity of the bisulphide of carbon to form a paste or mixture of creamy consistence. The temperature employed was about 160° C., and inasmuch as the chemical reaction gave rise to the liberation of large quantities of gas the author recommended that the tubes should be opened once daily to relieve the pressure, again sealed, and then returned to the oil bath. When the reaction was judged to be practically terminated the liquid contents of the tubes were poured off as close as possible, the remaining portion being separated by distillation from the black sulphide of lead, and the whole liquid product purified by the same means. After the excess of bisulphide of carbon, and small quantities of acetic acid and acetone had passed over the temperature rose gradually to 137° C., and the boiling point remained constant, when a pungent liquid of acid odour, attacking the eyes and nostrils, was collected, which proved to be acetic anhydride  $C_4H_6O_3$ . Its formation would be thus explained:



The acetate of silver gave similar results with even greater facility. The author then proceeded to apply the principle of this reaction to the formation of compound ethers, and to the isolation of certain anhydrides of electro-positive radicals or ethers. In order to procure the acetate of phenyl, the corresponding lead salt was sealed up in tubes with an equivalent quantity (or better only half an equivalent) of phenylic alcohol, and a considerable excess of bisulphide of carbon. The tubes were then heated in an oil bath to the temperature of about 170° C., when the expected reaction soon commenced, and proceeded with great ease and regularity, on account of the solubility of the lead salt in the phenylic alcohol. The pressure of gas accumulating as before, rendered it necessary to open the tubes repeatedly, and when eventually the escape of gas had nearly ceased, the liquid contents were separated and submitted to distillation. The products which came over first were the excess of bisulphide of carbon employed, and acetic acid, with a small proportion of acetic anhydride; when the temperature rose to 190° C., a liquid of pleasant empyreumatic odour made its appearance, which proved to be the substance in question. The acetate of phenyl, after rectification, had a constant boiling point of 200° C., and vapour density equal to 4.72 — a number not widely different from 4.59 demanded by theory. Its properties were thus described:—A colourless, fragrant, liquid becoming somewhat yellow by keeping, of specific gravity 1.074, neutral to test-papers. It is slightly soluble in water, to which it imparts its peculiar odour; boiling alkaline solutions dissolve it with production of mixed acetate and phenate. Its index of refraction appears to be identical with that of German fusible glass (a fact demonstrated at the meeting by the exhibition of a small sample bottle of the ether, in which were immersed short lengths of glass rod, that became almost invisible, even upon close inspection). The author suggests the application of the same process as a mode of forming ethers of the phenylic series, of which the preparation has hitherto presented difficulties; and, lastly, refers to experiments upon which he is at present engaged, whereby he hopes to eliminate phenylic ether from phenate of lead. The author concludes by pointing out the possible application of this process as a means of procuring a variety of double ethers and anhydrides, and mentions several reactions with other metallic salts which have been as yet but partially examined.

In proposing a vote of thanks, the PRESIDENT remarked upon the great interest attaching to Mr. Broughton's communication, and recommended a study of the intermediate steps in the reaction first described.

The next paper was read by Mr. J. SPILLER, and entitled "*On the Oxidation of India-Rubber.*" The author commenced by referring to the earlier researches of Dr. A. W. Hofmann, who communicated to the Chemical Society four years ago a statement of the changes which *gutta-percha* is found to undergo by free exposure to air, and especially under the influence of a hot climate; and it was then proved that the deterioration in quality of the insulating coating of the Indian telegraph wires was the result of a gradual oxidation of the natural gum.\* The author then proceeded to describe an interesting example of the gradual alteration of india-rubber, which was presented by an article of commerce known under the name of "Patent Waterproof Felt." This material serves the purpose of a cheap packing, and is used in the exportation of silk and other valuable fabrics, stationery goods, and many articles which are liable to be affected by damp; it is sold in sheets of great length and about a yard wide, and appears to be made by cementing or matting together the fibres of cotton wool through the intervention of india-rubber paste or solution, so that after the evaporation of the coal-naphtha or other solvent, and passing

\* Quarterly Journal of the Chemical Society, vol. xiii., p. 87.



through rollers, a continuous and water-repellent fabric is produced. About six years ago, Mr. Spiller purchased some of the waterproof felt, and made some useful applications of it in the way of photography; some of the material had, however, been laid aside until recently, when, upon examination, it proved to possess no longer the strength, close structure, and waterproof qualities of the original article. Finding this to be the case, the properties of the aged material were compared with a sample of recent manufacture, and the altered fabric examined in the same manner that it had been tested six years ago—viz., by extracting the rubber with benzol, and noting the character of the film left upon the evaporation of the solvent. When thus treated the original fabric furnished a beautifully white cotton flock, and a solution which, being evaporated, left a perfectly elastic film of pure india-rubber; and the same results were obtained upon the examination of the newly manufactured sample; but, on the other hand, the altered fabric when treated with warm benzol gave a discoloured cotton and a solution which left upon evaporation a resin, or brownish-yellow brittle substance closely resembling shellac. The chief examination of this interesting product was made upon the material extracted from the fabric by warm alcohol, which left insoluble, besides the cotton, a small quantity of unchanged rubber easily separated by filtration; and the amount of the brittle resin procured in this manner from a square foot of the fabric weighed, after complete evaporation of the solvent over a water bath, 74 grains. A considerable quantity of this altered india-rubber was thus prepared, and its chief properties were the following:—It is freely soluble in alcohol, especially if warmed, in wood spirit, chloroform, and in benzol as already stated. It is not appreciably soluble in ether, bisulphide of carbon, or oil of turpentine. Alkalies dissolve it with ease, and it may be reprecipitated from such solutions by neutralising with acids. Like india-rubber itself, it becomes bleached upon immersion in aqueous ammonia. The resin fuses below the temperature of boiling water, and when strongly heated in a retort gives off an amber-coloured oil of agreeable empyreumatic odour, besides furnishing water,—a proof of its containing oxygen. At ordinary temperatures it is extremely brittle and highly electric, so much that it cannot be powdered in an open mortar without loss. When rubbed with silk the substance exhibits the phenomena of “resinous electricity.” An analysis of the resin was made by combustion with oxide of copper which indicated the following percentages:—

Carbon	. . . . .	64.00*
Hydrogen	. . . . .	8.46
Oxygen	. . . . .	27.54

For the reasons adduced by Dr. Hofmann in the case of the altered gutta-percha examined by him, Mr. Spiller abstained from constructing a formula, merely regarding this substance as an oxidation product formed directly from caoutchouc by the absorption of atmospheric oxygen in much the same manner that resins are formed from essential oils and other hydrocarbons.

Dr. WARREN DE LA RUE stated that he once had an opportunity of inspecting the manufacture of the waterproof felt at Manchester, and the mode of procedure was substantially as described by Mr. Spiller. The india-rubber softened by benzol or some other solvent, to the condition of a thick dough, was applied to the cotton fibres by means of rollers. The ordinary material did not contain sulphur, but he had in his possession samples prepared eighteen years ago which were vulcanised by admixture of sulphur

\* In writing these numbers upon the board Mr. Spiller placed in comparison with them the figures representing one of Dr. Hofmann's compounds from gutta percha, viz.:—

Carbon	. . . . .	62.79
Hydrogen	. . . . .	9.29
Oxygen	. . . . .	27.92

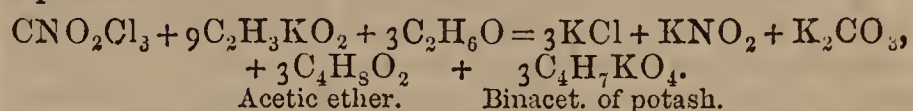
and subsequent heating, and they had remained throughout this long period of time in their original condition.

Professor ABEL said that nine years ago he had occasion to examine some of the india-rubber goods which were returned from the Crimea, and found in several instances a kind of resin, very similar to shellac, which at the time he believed to be evidence of sophistication. This was detected only in the unvulcanised materials, and there could be little doubt, after the discoveries of Dr. Hofmann and Mr. Spiller, that the deterioration observed was attributable to the action of oxygen upon the india-rubber, promoted by the state of porosity consequent upon the large quantities of mineral matter which he found to be present in the waterproof material.

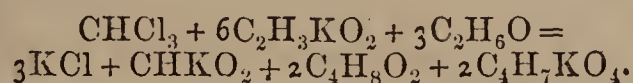
Mr. SPILLER further stated that he had succeeded in preparing combinations or mixtures of caoutchouc with the resin just now described, by impregnating sheets of india-rubber with solutions of the oxidised substance, and then allowing the solvent to evaporate. Such compounds were inferior to pure rubber in the qualities of softness and elasticity. With regard to the resin itself, the physical properties and the analytical results seemed to indicate that gutta-percha and india-rubber both furnish the same ultimate product by the absorption of oxygen.

Dr. GDLING suggested that the colour of the resin might be accidental, and that possibly white gutta-percha, as prepared by precipitation from its solutions by alcohol, might furnish a white resin. Like shellac itself, the resin might, perhaps, exist in two states—white and coloured.

Mr. HENRY BASSETT then communicated a “*Note on the Action of Chloropicrin and Chloroform on Acetate of Potash.*” When chloropicrin is heated with fused acetate of potash and alcohol to 100° C. in a closed vessel, the first-named substance is decomposed with great readiness, forming an abundance of chloride of potassium without disengagement of gas. The author obtained the best results when he employed nine equivalents of the acetate to one of chloropicrin, which gave rise to the production of acetic ether and binacetate of potash, besides carbonate, nitrite, and chloride of potassium, according to the following equation:—



The author remarked that the last-named product was not nearly so deliquescent as the ordinary acetate of potash, and that it rotated violently on the surface of water. Chloroform treated in a similar manner did not suffer any appreciable decomposition at the temperature of 100° C., but when the heat was raised to 125° C. the chloride of potassium was quickly formed. Upon opening the tubes a small quantity of carbonic oxide escaped, and formiate of potash, besides acetic ether and binacetate of potash, were generated, the reaction being similar to the previous example:—



The author concludes by describing the action of aniline upon chloropicrin, which at the temperature of 145° is somewhat violent, much nitrogen being evolved. On digesting the product with boiling water, a red colouring matter is dissolved out, which appears to be similar to that obtained by Dr. Hofmann as the result of the action of tetra-chloride of carbon upon aniline. The solution also contains the hydrochlorate of a solid base, the platinum salt of which was analysed with results closely agreeing with that of carbo-triphenyl-triamine. Mr. Bassett is now engaged in studying the action of cyanide of potassium upon chloropicrin.

In answer to the President, Mr. BASSETT stated that in the absence of alcohol the chloroform remained unacted upon.

The following paper was then read by the SECRETARY,



viz., "On a Dense Brine from Saltsprings, Nova Scotia," by Professor How, D.C.L., University of King's College, Windsor, N.S. The sample of water analysed was remarkable for containing unusually large quantities both of common salt and sulphate of lime, and formerly served for the commercial preparation of the first-named substance. Boracic acid and bromine were detected among the soluble constituents of the water. Its specific gravity at 53° F. was 1.046. The analytical results, stated in accordance with the plan of Fresenius, stand thus:—

	Grains per gallon.
Chloride of sodium . . .	4133.50
Chloride of calcium . . .	51.91
Chloride of magnesium . . .	27.33
Sulphate of lime . . .	154.73
Carbonate of lime . . .	3.77
Carbonate of magnesia . . .	2.93
Carbonate of iron . . .	.18
Silica . . .	.56
Total . . .	4374.91

The brine in question contains, then, nearly twice as much salt as sea water, and is nearly on a par with the strongest saline water of Canada, which contains 4762 grains of dissolved constituents in a gallon. The remaining portion of the author's paper is devoted to a comparison of the leading constituents of this water, with the amounts contained in a variety of other samples from all parts of the world. And, secondly, treats of the degrees of solubility of the carbonates of lime and magnesia in water alone, and when associated with other mineral salts.

The PRESIDENT remarked that the directions given by Dr. Fresenius had usually been followed in stating the results of water analysis; but it was not always correct to say that the strongest acids were united with the strongest bases. In seeking for the true method, one encountered the difficulty of placing every acid in part combination with every base. Such a measure would be practically impossible, although he believed it to be founded upon truth.

Dr. ODLING reminded the Society that the point raised by Dr. How with respect to the solubility of magnesia compounds had already been answered by Mr. Warrington, jun., in his recent communication. The speaker remembered the publication of a certain analysis of Thames water collected at Greenwich, according to which there were sulphate of soda and chloride of calcium among the saline constituents, but not a trace of common salt!

Mr. NEWLANDS asserted the fact of precipitated phosphate of lime being appreciably soluble in an aqueous solution of chloride of ammonium—a circumstance which stood in the way of the correct determination of this constituent in manures, &c., by simple precipitation with ammonia.

The PRESIDENT stated an observation to the effect that the calcic oxalate was practically insoluble in dilute acetic acid, but no longer remained so in the presence of certain mineral salts.

The meeting was then adjourned until March 2, when Dr. Crace Calvert would read a paper "On the Action of Silicate and Carbonate of Soda on Cotton Fibre;" and Professor C. L. Bloxam had promised a communication "On the Action of Chlorine upon Arsenic Acid."

#### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 7, 1865.

R. ANGUS SMITH, Ph.D., F.R.S., &c., President, in the Chair.

AMONG the donations announced was a framed photographic portrait of the late Thomas Hopkins, Esq., formerly a Vice-President of the Society, presented by James Mooney, Esq.

On the motion of Dr. JOULE, seconded by Mr. ROBERT WORTHINGTON, the thanks of the Society were unanimously voted to Mr. Mooney for his valuable donation.

The PRESIDENT drew attention to the late fatal explosion at Peterborough, and asked whether the easy method of testing steam boilers, described some years ago by Dr. Joule, was forgotten or found to be impracticable?

Dr. JOULE said that he had taken pains to give his method, by which the testing by hydraulic pressure could be applied with the utmost facility by simply filling the boiler with water and then raising its temperature a few degrees, a very extended publication. He believed that the objection raised by some to its use was the absurd one that hydraulic pressure injured the boiler. The very object of a test was to detect weak boilers for the purpose of strengthening or rejecting them. He was at a loss for terms strong enough to express his opinion of the reckless disregard of life, or the ignorance which resulted in the deplorable catastrophes which were constantly occurring; and he believed that the only method of cure would be that proposed by Mr. Binney in the case of the explosion of firedamp in mines—namely, that the parties to blame should be compelled to support the widows and orphans of their victims.

Mr. Alderman POCHIN stated that he had made use of Dr. Joule's plan, and found it quite practicable and easy of application.

A paper was read "On a New Reagent for the Separation of Calcium from Magnesium," by Edward Sonstadt, Esq., which we shall publish next week.

#### ACADEMY OF SCIENCES.

February 13, 1865.

IN a paper on "New Thermo-electric Piles formed of Metallic Sulphides," M. E. Becquerel recalls that so early as 1827 his father had remarked that a copper wire covered with sulphur was strongly positive in relation to ordinary copper, and upon this observation had constructed a pile of two copper wires, one covered with sulphur, and the other not, which, at from 200° to 300°, developed a force capable of effecting some electro-chemical decompositions. He proceeded to point out that sulphur profoundly modifies the electric properties of all metals, rendering the positive more positive and the negative more negative. A mixture of sulphur and bismuth, which can easily be melted together, for example, is strongly negative to bismuth itself; and a couple formed of sulphured bismuth and copper gives three times the electric force of the ordinary bismuth-copper couple. Protosulphide of copper, under certain molecular conditions, is eminently positive in relation to other mineral and metallic substances; and the author has accordingly constructed a pile composed of ten cylindrical bars of this substance, ten centimetres long, and one centimetre in diameter, with copper wire rolled round each extremity; and with this battery raised to 300° or 400°, he is enabled to decompose a solution of sulphate of copper, and work a telegraph. The author is still engaged in the construction and study of these piles, and now calls attention to the matter in consequence of Bunsen's announcement of his discovery of the thermo-electric properties of pyrites and pyrolusite.

M. H. St. Claire Deville publishes an account of further experiments "On the Dissociation of Carbonic Oxide, Sulphurous, Chlorhydric, and Carbonic Acids, and the Decomposition of Ammonia." We have published at page 2 of this volume an account of the apparatus which the author has devised to demonstrate the facts of dissociation, and all we need say here is that for his experiment with sulphurous acid the inner metallic tube which carries the stream of cold was silvered on its external surface. After the current of sulphurous acid had continued for some hours, the silver surface was found to be blackened or sulphuretted, and at the same time covered with a layer



of anhydrous sulphuric acid, showing that sulphurous acid had been dissociated or incompletely decomposed into sulphur, which was deposited on the silver, and oxygen, which combined with the excess of the acid to form sulphuric acid. Until now sulphurous acid has been considered completely undecomposable by heat. The author then shows how the same effect may be shown with the induction spark. To this description we shall return.

In the experiment with hydrochloric acid, the author amalgamated the silvered surface of the cold tube with a very small amount of mercury, and so obtained a very brilliant surface. After pure hydrochloric acid gas had passed for some hours, this surface was found covered with chloride, and by a peculiar arrangement the author was able to collect some hydrogen.

The experiments with carbonic oxide confirm the results detailed in the author's former paper, to which we have alluded above.

Carbonic acid has only been experimented upon with the induction spark. The author now shows that by placing a ball of phosphorus on the surface of the mercury in the eudiometer tube, and continuing the spark for some days, the carbonic acid will be completely dissociated, and only the same bulk of carbonic oxide found in the tube.

As regards ammonia, the author shows that the decomposition of this gas by the induction spark is never complete. It is true that when the volume of the gas has been doubled no absorption appears to take place when water is poured into the eudiometer tube. But if some hydrochloric acid gas be passed in, the presence of undecomposed ammonia is made manifest at once. This paper is of great interest, and we shall return to it on an early occasion.

An interesting report was read on the memoir of MM. Tresca and Laboulaye, entitled, "*Experimental Researches on the Mechanical Theory of Heat*," to which we can only direct the attention of our readers. The reporters, while accepting the author's determination of the mechanical value of an unit of heat, pay a high compliment to Mr. Joule, who was, they say, undoubtedly the first to assign an approximate value.

M. Tellier, in a note, suggested an application of ammoniacal gas, which is ingeniously adapted to the needs of some Parisian houses. Some account of the application is given in our Paris letter.

M. Cailletet communicated some "*Analyses of the Gases Produced in the Cementation of Iron*." The cementation was effected in a close iron box of his own contrivance, and the gas withdrawn by means of an expirator. We give the composition of the gas withdrawn at intervals:—

	After 8 hours.	After 32 hours.	After 60 hours.
Hydrogen . . .	26.60	39.80	37.76
Carbonic oxide . .	15.55	15.30	16.32
Carbonic acid . .	20.06	00.00	00.00
Nitrogen . . .	37.79	44.90	45.92
	100.00	100.00	100.00

The gases were washed as they came from the box, but no trace of cyanides was found in the water.

M. Friedel presented a note "*On the Action of Bromine on Isopropyl Alcohol and on Iodide of Isopropyle*." Bromine first removes 2H from isopropyl alcohol, transforming it into acetone, which seizes upon other portions of bromine to form substitution products; and hydrobromic acid set free converts a part into bromide of isopropyle. This action is analogous to that which takes place with bromine and vinic alcohol. The action of bromine on iodide of isopropyle differs from that which is exerted on iodide of ethyl, and thus isopropyl alcohol, and probably the other alcohols derived from acetones, are found to occupy a place intermediate between true alcohols and the pseudo-alcohols of Wurtz. They resemble the former in their behaviour towards bromine, and the second in their

property of giving by oxidation aldehydes not susceptible of being transformed into acids (acetones).

M. Verstraet communicated "*A New Method of Estimating Sulphides by Means of Ammoniacal Nitrate of Copper*." This we shall transfer to our pages.

MM. Moutier and Dietzenbacher presented a note "*On a Property of Sulphur*." The second of these gentlemen showed some time ago that sulphur melted with a small proportion of iodine retained its plastic state. The authors now show that a number of other substances,—naphthaline, paraffin, camphor, oil, wax, &c., confer the same property. The mixture with some of these substances is insoluble in sulphide of carbon. Carbon also greatly modifies the properties of sulphur, rendering it completely fluid at 270°.

## NOTICES OF BOOKS.

*On Food as a Means of Prevention of Disease.* By ERASMUS WILSON, F.R.S. London: Churchill and Sons. 1865.

ALTHOUGH there is little to be said about progress in the art of curing diseases, much might be written on the advance made in our knowledge of the means of preventing them. Hygiene is far in advance of therapeutics. It is no great wonder that it should be so; for a little observation and some common sense are all that is required to develop the laws of the one, while varied knowledge, deep thought, patient experiment, and rigid induction must be exercised before any real advance can be marked in the other.

Amongst the means of preventing disease a sufficiency of wholesome food is unquestionably the most important. The morbid effects of foul air and impure water are transient compared with the results of underfeeding, and, moreover, may be often resisted with a sufficiency of food. Cholera and fever (the constant companion of famine) kill their victims or leave them much as they were before; but improper food, or an insufficiency of food, produces other disorders of body and of mind, which transmit their evil influences from generation to generation.

With the richer classes the remedy is in their own hands. As regards the poor, the philanthropists and the economists must bestir themselves, if it be true, as Mr. Wilson tells us, that three meat meals a-day are necessary to keep man, woman, and child in sound health.

Most of Mr. Wilson's little book is devoted to remarks on the dietary of infancy and childhood, and on that account it should be read by every parent who is anxious to secure the health of his offspring. What, however, with the caprices of children's appetites and exigencies of various sorts, probably few readers will be able to carry out the suggestions. Children, he says, are almost universally underfed, and the majority of the diseases of childhood arise from the debility of constitution induced by this habit of underfeeding. The preventive measure is three meals a-day, consisting of one-third vegetable and two-thirds animal food. We shall not stop now to point out—for we shall no doubt have shortly to notice another little book by some medical man pointing out—the many evils which may result from an excess of animal diet, and, moreover, it is beyond our business to concern ourselves minutely with these matters.

Mr. Wilson is a "specialist," and all his illustrations of the effects of improper food are borrowed from his own practice in skin diseases. But he can see beyond the skin, and we quote the closing paragraph of his book with much satisfaction, as embodying the opinion of a sensible, observant, well-informed medical practitioner:—

"I must not be supposed to undervalue light and air, and cleanliness and exercise, the kindred of food; but if it were my commission to improve the human race, to



produce finer, stronger, and better men, to extinguish disease, I should begin with food; and if it were my duty to lay down rules for the prevention of disease, I should, in the first instance, endeavour to secure the co-operation and influence of man's first and best friend—his stomach."

*Bulletin de la Société Chimique de Paris, &c.* January, 1864.

WE notice here a decree of the Emperor recognising the Chemical Society of Paris as an institution of public utility, and approving the statutes of the Society, no alteration in which can now be made without the sanction of the Emperor.

Among the proceedings of the Society we have the papers of M. Deville "*On the Dissociation of Carbonic Oxide,*" and "*On the Constitution of Sal-ammoniac and on Vapour Densities.*" Appended to the latter is a note by MM. Deville and Pebal "*On the Action which the Vapours of Sal-ammoniac and Hydrochloric Acid exert on Mercury.*" Dissociation the authors define as the partial separation of the elements, below the point of total decomposition, and they endeavoured to determine the tension of the hydrochloric acid and ammonia in the salt not decomposed. They placed a little sal-ammoniac and a few grammes of mercury in an ordinary vapour density balloon, and arranged the drawn out end so as to collect any gas if evolved. The balloon was then placed in a bath of boiling mercury vapour, and kept there for two hours. No gas was produced, but some absorption evidently took place, as if some gas had disappeared, which was probably oxygen from some air unavoidably present. After cooling the sal-ammoniac in the balloon was dissolved in water, and only a trace of chloride of mercury was discovered, corresponding probably to the small amount of air present.

Taking into consideration the alterability of mercury in the presence of hydrochloric acid, the authors conclude that the tension of dissociation of sal-ammoniac in its own vapour is very low. In another experiment they kept vapour of mercury in a continuous current of pure dry hydrochloric acid gas. In this experiment the amount of chloride of mercury found was less than in the other, and no hydrogen was collected. In this case the authors suppose the chloride to have been formed in consequence of a small amount of oxygen present with the hydrochloric acid. The experiment proved that pure hydrochloric acid and mercury exerted no influence on one another at  $360^{\circ}$ , but led to no conclusion as regards the tension of the dissociation of sal-ammoniac at that temperature.

Most of the other papers in the proceedings have already been noticed by us, but we find one "*On the Chemical Constitution of 'Vert de Guignet,'*" by M. Scheurer Kestner, which we have not seen before. Our readers will remember the analyses of this substance by Mr. Shipton, given from Dr. Hofmann's Exhibition Report at page 275, vol. viii., CHEMICAL NEWS. Mr. Shipton regarded the compound as borate of hydrated oxide of chromium. M. Kestner considers the boracic acid as an accidental ingredient, and believes the colour to be essentially hydrated oxide of chromium, which obstinately retains some boracic acid. The colour, we may say, is formed by fusing together boracic acid and bichromate of potash, and then well washing the mixture, which leaves behind the green substance in question. The reaction which actually takes place in the fusion, and the exact constitution of the colour, may still be regarded as doubtful.

**Chemical Society.**—The next meeting of this Society will be held on Thursday, March 2, at 8 o'clock, when the following papers will be read:—"Action of Silicate and Carbonate of Soda on Cotton Fibre," by Mr. Crace Calvert; "Bi-hydrate of Oxide of Phenyl," by Mr. Crace Calvert; "Action of Chlorine on Arsenious Acid," by Professor Bloxam; "A New Cornish Mineral," by Mr. Church.

## NOTICES OF PATENTS.

1406. *Apparatus for obtaining Extracts from Tea, Coffee, &c.* E. LOYSEL, Clapham. Dated June 6, 1864. (Not proceeded with.)

THIS specification describes an improved construction of Loysel's apparatus, in which the process of filtration of the tea or coffee extract is conducted by the pressure of the atmosphere.

1409. *Dyeing and Printing.* E. J. HUGHES, Manchester. A communication. Dated June 7, 1864.

THE patentee claims the production of a black dye on cotton or linen cloth or yarns by the use of a salt of aniline, in conjunction with chlorate and chromate of potash, and the sulphides of copper or iron. This method of proceeding is very similar to that described by Mr. Lightfoot, and appears to be identical with that of M. Lauth, given at page 65 of our present volume.

1418. *Separation of Animal Substances from Rags of Mixed Fabrics.* A. T. WELD, Gravesend, and J. F. POWELL, Albion Place, Hyde Park. Dated June 7, 1864. (Not proceeded with.)

THE main features of this invention coincide with those of the earlier patent of Mr. F. O. Ward and Captain Wynants, which was rewarded by the bestowal of a prize medal at the International Exhibition of 1862. For a full account of this ingenious process the reader is referred to pages 149 and 150 of Dr. Hofmann's Report.

1468. *Sheathing Ships.* J. BROWN, Aldgate, J. T. WAY, and T. M. EVANS, Leadenhall Street, London. Dated June 14, 1864.

INSTEAD of employing marine glue for the attachment of glass or vitreous-coated plates to the bottoms and sides of ships, the inventors propose to make use of a kind of glue already described in a former patent (No. 2629, of the year 1863), and to employ in conjunction with it canvas or other textile fabric coated on both sides with the glue in question, and upon this surface the warmed glass or vitreous plates are laid. When used upon the coatings of iron ships, it is preferred to apply heat to the metal itself prior to spreading the glue or coated fabric, and either to warm the exterior surface of the glue or the glass plates themselves to secure their firm attachment.

1483. *Cultivating Land in order to Increase the Productive Power thereof.* A. ELLISSEN, London. Dated June 15, 1864. (Not proceeded with.)

THE inventor proposes to sink into the earth a number of zinc and copper plates in alternate series, and to make connection between them by wires or other suitable conductors, so that a galvanic action may be excited, and circulate through the contiguous earth, and the fertilising power of the land become in consequence vastly augmented!

1486. *Preserving Iron Ships and Ships' Sheathing from Corrosion and Fouling.* R. WHITESIDE, North Egremont, Cheshire. Dated June 15, 1864.

THIS invention is said to be an improvement upon the system of protecting the copper sheathing of ships by the adaptation of zinc plates. The patentee purposely avoids the constant metallic connection of the two metals by interposing a layer of gutta-percha or other non-conducting material, and, whilst thus insulating the zinc from the copper, provides the means of connecting them at will by wires brought on board the ship. It is recommended to couple the wires occasionally for the purpose of preventing the corrosion of the copper sheathing, and to disconnect at intervals, when the fouling or marine accumulations will be cleared off. For the protection of ships built or



cased with iron, the inventor proposes to use two supplementary metals, with suitable wire connections, led on board the vessel, and by employing one metal which is positive, and another which is negative, to iron, the electric condition of the sheathing may be entirely under control, and both fouling and corrosion obviated in the manner already indicated.

## GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

282. G. J. Vertue, Weymouth, Dorsetshire, "Improvements in the manufacture of oil cake and food for animals."

284. J. Moysey, Leytonstone, Essex, "Improvements in coating the bottoms and sides of ships and other submerged structures to prevent fouling and decay."—Petition recorded Feb. 1, 1865.

42. J. Lebandy, Paris, France, "A new system of boiling grain sugar in vacuo."—Jan. 6, 1865.

59. W. Baker, Sheffield, Yorkshire, "Improvements in the manufacture and refining of iron and steel."—Jan. 7, 1865.

127. J. Young, Limefield, Mid Lothian, N.B., "Improvements in producing gases and vapour in a heated state."—Jan. 14, 1865.

160. M. B. Mason, New York, U.S.A., "Improved method of purifying and oxidising metallic ores."

168. T. Labroussee, Prussia Street, and J. Keily, Grangegorman, Dublin, "Improvements in dyeing leather."—Jan. 19, 1865.

221. G. Haseltine, Southampton Buildings, Middlesex, "A new process of manufacturing syrup and sugar from maize and other cereal grains."—A communication from F. W. Goessling, Buffalo, N. Y., U.S.A.—Jan. 26, 1865.

263. J. A. Laurent and J. Casthelag, Paris, France, "Improvements in the manufacture of benzoic acid."—Jan. 30, 1865.

## NOTICES TO PROCEED.

2465. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, France, "Certain improvements in photography for obtaining images direct on cloth and other materials." A communication from J. N. Truchelut, Paris, France.—Petition recorded Oct. 6, 1864.

2484. J. G. Beckton, Whitby, Yorkshire, "Improvements in heating retort and other ovens for the distillation of shale, coal, and other substances."—Oct. 10, 1864.

2503. J. W. Nottingham, Kennington Road, Surrey, "An improved composition for lighting fires."—Oct. 11, 1864.

2511. J. Möller, Shaftesbury Villas, Hornsey Rise, Middlesex, "Improvements in the preparation or manufacture of colouring matter for marking ink, and other purposes."—Oct. 12, 1864.

2526. R. A. Brooman, Fleet Street, London, "Improvements in the manufacture of prussiates of ammonia, and the application of prussiates of ammonia to dyeing, printing, and to photography." A communication from A. Baudesson and P. Houzeau, Reims, France.—Oct. 13, 1864.

2559. A. Hill, Birmingham, Warwickshire, "Improvements in privies, dry closets, and commodes, and in deodorising substances, to be used in privies, dry closets, and commodes."—Oct. 17, 1864.

2966. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the mode of, and apparatus for, stopping bottles."—A communication from H. B. Goodyear, New Haven, Conn., U.S.A.—Nov. 28, 1864.

207. G. Haseltine, Southampton Buildings, Middlesex, "Improvements in the mode of, and means for, preserving fruit and other eatables."—A communication from B. M. Nyce, Indianapolis, Indiana, U.S.A.—Jan. 24, 1865.

229. J. G. Willans, St. Stephen's Crescent, Bayswater, Middlesex, "Improvements in the manufacture of iron and steel."—Jan. 26, 1865.

244. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of oils obtained from the distillation of tar, and in the application of the same to the purposes for which ordinary drying oils are applicable."—A communication from C. and V. Cordier, Paris, France.—Jan. 27, 1865.

## CORRESPONDENCE.

### Continental Science.

PARIS, February 22.

AMONG the facts which will most interest your readers I may mention the completion of the "Dictionary of Pure and Applied Chemistry," by Liebig, Wöhler, and Pogendorff. This work was commenced in 1837, and the last part of the final volume has just been issued. In the meantime a second edition of some of the earlier volumes has been published. I know of no chemical work which has taken the same time to complete. Gmelin's "Handbook" was begun by the Cavendish Society in 1847 or 1848, I think, and so has been a tolerably long time in hand; but at present there is a difference of ten years in favour of the Society. One would think that the time for large chemical dictionaries and cyclopædias had either passed or had not yet arrived.

M. Bergeron has published a paper on the manufacture and use of aniline colours considered from a hygienic point of view. He has observed that the vapours of benzole and acetic acid produce no ill effects on workmen, but that those of hyponitric acid do produce disorders of the respiratory organs. The vapours of nitrobenzole and of aniline cause various functional disturbances of the stomach and nervous centres, some of which seem to disappear after the workmen get accustomed to the vapours, but which sometimes produce more serious effects—fainting, delirium, coma, and convulsions. He remarks also a general anæmic condition among the workmen.

While on the subject of health I will just extract some numbers which show the general extension of the duration of life in France during the present century. In 1806—9 the average duration of life was—in males, 30 years, 6 months; in females, 32 years, 7 months; mean, 31 years, 6 months. Now, in 1865, it is calculated that males on the average live 33 years, 4 months; and females, 36 years, 4 months; mean, 34 years, 10 months. This extension is remarkable, taking into consideration the fact that for many years the number of the population has been almost stationary, or, at all events, has increased in a much smaller ratio than that of Great Britain, notwithstanding the enormous emigration which has gone on from the latter.

I cannot resist here copying the announcement of a very sensible disposition of property which has just been made by a Madame Pailloux. It may serve as a hint to some charitable or, possibly, vain person who may be thinking about leaving a large sum of money to some overgrown hospital in London. The benevolent lady in question has left a good country house and 1000 francs a-year for a doctor to attend gratuitously the poor of the commune in which she lived, either at their own houses or at an asylum, which she has also endowed for aged and necessitous agriculturists. Considering the remuneration Poor-law doctors receive in England, and that large hospitals are almost certain to become in time nests of crisyelas and pyæmia, and so kill rather than cure people, the will of Madame Pailloux is one which might be advantageously imitated in England.

It is rather early to speculate on the matter, but the last number of the *Journal of Practical Agriculture* reports



that at present the prospects of this year's corn harvest in France are very satisfactory.

M. Menard has introduced some improvements in the method of fermenting grape juice. He has remarked that the exposure of such a large surface in the vats causes a considerable loss of alcohol by evaporation and also much of the bouquet. He therefore proposes to ferment in a closely covered vessel, and to carry the evolved gases and the volatile matters through a cooled washing apparatus, which detains these last. The wines fermented in this way he finds to possess a much superior flavour, and also 1 per cent. more alcohol.

The volatile products of fermentation have not, that I remember, been much studied. An old man who had worked in a London brewery I remember once told me that his master (who was certainly a scientific brewer) fermented beer under much the same conditions that M. Menard fermented his wine, and condensed a small quantity of liquid, two or three drops of which would quickly kill a strong cat. Do you know any record of any such experiments?

At Rivières they make tiles and bricks of a sandy clay which contains 32 per cent. of chalk. When first burnt they are so tender that unless they are carefully handled they fall to pieces. As soon, however, as they are cold enough to touch they are quickly removed from the furnace and carefully stacked. They are then soused with water, by the action of which they are so hardened that they may be used the next day for building. This fact is, perhaps, easily capable of a chemical explanation, and brickmakers may be able to gather a hint from it.

M. Tellier has found in the ready solubility of ammoniacal gas an easy means of producing a vacuum, and he has made an ingenious application of the fact. You are aware that present arrangements in Paris necessitate the occasional emptying of closets, to which arrangements, indeed, you may one day return in London. As at present conducted here, this is not an easy or savoury operation, but by M. Tellier's plan the difficulties and *desagrèments* are removed at once. He fills a close iron box with ammoniacal gas, and transports it to the *vidange* to be emptied. A little water is allowed to enter the box, and a vacuum is created, and now a pipe from the box being plunged into the cesspool, the contents are forced up into the box, which can be carried away without the least offence.

Sericulture is rapidly recovering here. M. Renard has lately distributed 800 ounces of healthy eggs from Yokohama to the silk-cultivating districts in France to assist in replacing the stock destroyed by disease.

#### On Cotton Seed Oil.

To the Editor of the CHEMICAL NEWS.

SIR,—When, in the first number of your valuable paper for the current year, I gave a short abstract of some experiments on cotton seed and cotton seed oil some of my experiments were not sufficiently far advanced to be ready for the press. I have now the pleasure to communicate some further details.

The crude oil is eminently adapted for soap making: it can be made to yield both soft and hard soap and also lead soap (lead plaster). One hundred parts of the crude oil gave on experimenting on a small scale—viz., with a quantity of one imperial pint, weighing 8138.36 grains, 291.63 parts per cent. of soft soap, which at the time it was made, in November, 1864, contained 52.3 per cent. of water, but since it has constantly become more fluid, and when now a short time ago I estimated the proportion of water again I found its percentage increased to 65.74 per cent. The yield of soap with soda is at the rate of 169.33 parts for every 100 parts of oil; this soap only contained 38.7 per cent. of water, and I found, as is by no means unusual with soda soaps, that this soap is becoming more dry. Potassa soaps made with pure alkali always are liable to absorb moisture, especially if made

from oils only without admixture of tallow or resin. I prepared a lead soap by directly saponifying the oil with oxide of lead, as well as by precipitation from the potassa soap by means of a dilute solution of acetate of lead; 100 parts of potassa soap yielded 57.19 of dry lead soap. The dark colour of the oil is conspicuous in all these soaps, but less so in the soda soap; still, where the colour is no objection, the crude oil might perhaps be profitably applied for making a cheap lead plaster. As regards the so-called refining of the oil, i.e., the abstraction of the dark colour accompanied by improvement in taste, I found that a simple expedient will have the desired effect, viz., washing of the oil with a solution of caustic potassa or soda; but in nearly every case it will be previously necessary to submit the oil to a thorough steaming and washing with boiling water, so as to remove from the oil as much as possible the mucilaginous and albuminous matters met with in the crude oil, sometimes to a very large amount: if this precaution is neglected there will be more waste—that is to say, that a larger quantity of alkali is required, and in consequence thereof a larger proportion of the more solid fatty matter of the oil is abstracted. It appears to me that the action of the alkali (it even acts at ordinary temperature of the air) is not simply the rendering soluble of the dark colouring matter in water, but a portion of the oil is saponified, viz., the more solid fat it contains; while with the abstracting of the colouring matter the glycerine also appears to be abstracted. The mixed liquids—alkaline lie and oil—after having been thoroughly beaten up together separate in three distinct layers on being left to repose; the upper one is the nearly colourless, so-called refined oil, the middle layer is the still yet dark coloured, saponified solid fat of the oil, while at the bottom is found the dark almost black coloured alkaline lie. Owing to the great discrepancy of impurity of the crude oil (some being evidently pressed from damaged seed) it is not well possible to say correctly what yield of purified oil will be obtained. I found under the most favourable circumstances that 100 parts of the previously steamed oil yielded from 85 to 88 parts of refined oil.

I made elementary analyses of the crude oil and two lead soaps—viz., one obtained directly, the other by precipitation from the potassa soap, the result being as follows:—

	Lead soap (direct).	Lead soap (precipitated).
Carbon . . .	32.41	44.811
Hydrogen . . .	4.62	6.808
Oxygen . . .	6.77	13.381
Oxide of lead . . .	56.20	35.000
	100.00	100.000
		Crude oil.
Carbon . . .		73.85
Hydrogen . . .		11.05
Oxygen . . .		15.10
		100.00

I must hereby observe that the two soaps were made from different (not the same) samples of oil, and that the crude oil, the elementary analysis of which is herewith appended, is a different sample again, which had not been submitted to any treatment, save filtration through paper at 212° to assist its running through. This oil as well as other samples I tested, distinctly yields with Lassaigne's test the reaction for nitrogen, though not in sufficient quantity for estimation.

The ultimate constituents of this sample of crude oil approach to those of castor oil (also a drying oil) which is as follows:—

Carbon . . .	74.15
Hydrogen . . .	11.03
Oxygen . . .	14.78



The potass soap analysed a short time ago, after having been gradually taking up water, gave as result of analysis :

Water	. . . . .	65.740
Potassa	. . . . .	9.296
Fatty acids and colouring matter	. . . . .	24.964

100.000

I have by various means tried to obtain directly and quantitatively the glycerine contained in the crude oil, but have never succeeded in getting it (the glycerine) free from colour ; a series of experiments, made with due care, gave me results varying between 18.10 and 19.90 per cent. The crude oil gives off a very sweet smell, somewhat like treacle ; its taste, also, is very sweet, without being accompanied by any acidity. I have some reason to believe that the crude oil contains a peculiar kind of sugar, and this may account for the large amount of glycerine found.

I am, &c. Dr. A. ADRIANI.

#### The Sugar of the Future.

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to your correspondent P. L. Simmonds, I request you to insert in your valuable paper the following remarks. Dr. de Vry in his note to me uses the expression *Canna indica*, a far more ancient Latin name given to sugar cane than the name *Saccharum officinarum*, first introduced by Linnæus. The French still often say *Cannes des Indes* in speaking of sugar cane. I am certain Dr. de Vry as well as myself are aware of the enormous quantity of sugar consumed per annum throughout the globe, and I am also sure Dr. de Vry knows, as well as anybody else, what soil is needed for rice during a portion at least of its time of development, but Dr. de Vry evidently included in the general term rice other cereals.

Although the Arenga palm sugar is spoken of as sugar of the future, it may be so distant a future that to your correspondent as well as to many of the present day may apply the words of the well-known University song, "*Ubi sunt qui anti nos in mundo fuere?*"

I am, &c. Dr. A. ADRIANI.

P.S.—I enclose Dr. de Vry's original letter as *pièce d'évidence justificative*.

[We have verified Dr. Adriani's translation, or rather transcription, by a reference to Dr. de Vry's original letter, in which the latter certainly writes *Canna indica*. It is unfortunate that the same term should be used to indicate both the sugar cane and the plant which furnishes *tous-les-mois*.—Ed. C. N.]

#### The Chemical Report.

To the Editor of the CHEMICAL NEWS.

SIR,—Mr. Foster is quite wrong in supposing that any error he may have made led me into mistake. The facts are, as I stated, that I called repeatedly at Messrs. Bell and Daldy's, and inquired for the Report, the last time as soon as I knew it was in circulation, and then I was distinctly informed—or, at all events, I supposed so at the time—that there were none for sale separate from the volume.

As the matter stands, I should rather like to know how many days the Report was on sale separately, and what steps the Society of Arts took to make known the fact.

I am, &c. A CHEMIST.

February 15.

To the Editor of the CHEMICAL NEWS.

SIR,—In answer to Mr. Le Neve Foster's letter in your last week's CHEMICAL NEWS, and in verification of your own remarks in reference thereto, I beg to say that two or three friends of mine who had seen a copy of the Report, Class II., Section A (which was kindly sent me

by the learned author), were each anxious to obtain a copy for themselves, and, applying each through their own bookseller, they were informed, in due course, that the Report in question was not sold only in connection with the "whole Report of the Exhibition."

I am, &c.

J. M.

Burton-on-Trent, February 21.

#### Deposit in Brewers' Casks.

To the Editor of the CHEMICAL NEWS.

SIR,—Upon the occasion of a recent visit to a porter brewery in this city, I noticed on the lids of the cleansing casks a hard, brown crust, which seemed to me of a nature requiring chemical examination. I accordingly scraped off with a knife about 250 grains of it ; and upon testing it at my leisure, was surprised to find that it, in the main, consisted of oxalate of calcium. The exact constitution of this deposit was the following :—

Water	. . . . .	38.96
Organic matters	. . . . .	12.70
Oxalate of calcium	. . . . .	39.94
Soluble salts	. . . . .	8.30
Silox	. . . . .	0.10

100.

Some scientific friends to whom I have mentioned this fact look upon it as novel, and possessed of some interest in connection with the subject of fermentation. Should you participate in this view, I will thank you to allow this notice a place in the columns of the CHEMICAL NEWS. I may, in conclusion, observe that at the time when I collected the oxalic deposit, there was much complaint in relation to the rapid souring of the porter of the brewery, and that a very considerable pecuniary loss had thereby been sustained by the proprietors of the establishment.

I am, &c.,

JAMES APJOHN.

South Hill, Blackrock, February 18.

#### MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week :—Monday, February 27, at 3 o'clock, Professor Tyndall, F.R.S., "On Electricity." Tuesday and Thursday, February 28 and March 2, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Wednesday, March 1, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System." Friday, March 3, at 8 o'clock, James Fergusson, Esq., F.R.S., "On the Temple and Holy Sepulchre at Jerusalem."

**London Sewage.**—The Corporation of London, unwilling to give up the idea of the enormous value of London sewage, and relying on the figures and fancies of Liebig, have agreed on a strong report against the arrangement of the Metropolitan Board of Works with Messrs. Napier and Hope, which, if carried out, they say, would be a glaring violation of the laws of agriculture, producing the smallest increase of food, and the smallest return to the ratepayers. They ask for yet another Parliamentary inquiry into the economic utilisation of sewage.

**Researches of M. Stas.**—A full account of M. Stas' earlier determinations of the atomic weights of elements, and also his later researches on the laws of chemical proportions, the author kindly informs us, will be placed in our hands in about three months, when we shall reproduce them as fully as possible. It may be said without fear of question that for rigorous exactitude these are the most important contributions ever made to our knowledge of the subjects to which they relate. In the first series the author sought to determine whether the laws of chemical proportions were absolutely exact or merely limited laws. He has here demonstrated that these laws



are *mathematical*, as all chemists have hitherto believed, but no one before proved. Mere analysis and synthesis, as the author states, could never prove this; and he has, therefore, resorted to other means of proof, which will be found described in his memoir. In a second series he sought to determine whether the atomic weight of silver was constant, when deduced from the iodide, bromide, and chloride. The memoir describing these researches will give some important improvements in the methods of effecting the analysis and synthesis of these bodies, these new methods affording the means of accurately determining the errors of each operation. The third memoir extends and confirms the author's previous researches on nitrogen, chlorine, potassium, and sodium, and adds lithium to the bodies examined. The publication of these memoirs will remove the last doubts (if any chemist entertains them) of the inaccuracy of Prout's law.

**Note on Tobacco Smoking.**—Tobacco smoking is a process of *distillatio per decensum*, in which the vapours of the substance submitted to distillation, are not, as is usually the case, caused to descend by their own tension, but by the downward flow of a current of air, induced by the continuous production of a partial vacuum beneath the distilled body. The air which enters the mouth of a pipe issues from its stem after passing through a layer of ignited tobacco, carrying with it, among other things, watery vapour, carbonic acid, and nitrogen, together with the vapours of, or the products of the action of heat on, nicotine, a gummy matter, a resinous body, and a bitter principle. The distilled products of course vary with the nature of the tobacco, and the treatment to which it has been subjected; the amount of watery vapour varies greatly. In a sample of Turkish tobacco which did not appear moist, more than 22 per cent. of water was found to be present by drying in an air bath at 95° C. If the contents of a pipe be partially smoked and then examined, three distinct layers will be found. The first and uppermost consists of the ash of tobacco; the second consists of carbonised tobacco—that is to say, of tobacco which has been submitted to the action of heat sufficiently intense to cause its volatile parts to pass away, but not sufficiently intense to cause the oxidation of its carbon; the third layer consists of tobacco unacted upon. If a pipe is smoked by means of an aspirator, and the distillate examined, the smoke is found to be alkaline, and a quantity of water collects in the recipient, in which are suspended dark flakes of brown matter, and upon which an amber-coloured oil floats. A greater quantity of this latter may be collected by heating to redness a meerschaum plug which has been in a pipe for some length of time. A plug which had been for some weeks in a pipe in which Turkish had been smoked, weighed 1.0670 gramme, after heating to redness, .4850 gramme; a second, from a pipe in which Turkish and Latakia had been frequently smoked, weighed .9710 gramme, and after heating to redness, .3570 gramme. On first heating a plug, very dense, strongly alkaline, white fumes are given off at a high temperature, which quickly condense, partly to a brown solid, partly to a yellow oil. When tobacco is carbonised without access of air, the evolved vapours burn readily with a highly luminous flame. By placing a thermometer immediately in front of the stem-orifice of a pipe, which was smoked by an aspirator, the temperature of the issuing smoke was found to be 47° C. Smoke rings may be readily examined by watching the smoke as it ascends from a pipe bowl; rings are frequently seen to separate themselves from the rising smoke, both parallel and at right angles to the axis of the pipe bowl, and in intermediate positions. As the rings thus produced are only a few inches from the eyes, and as, moreover, the eyes can be readily brought immediately under them (by throwing back the head) we are able accurately to examine the movement of the rings

from the moment of their formation to that of their dissolution.—*G. F. Rodwell, F.C.S.*

**Camphor Water as a Solvent for Salts.**—It is more convenient to measure a liquid than to weigh a solid; many salts are therefore kept in solution, but they are at the same time very bad keepers. A very simple and efficacious mode of keeping them is to use *aqua camphorata*, i.e., a saturated solution of camphor in water, as the solvent. Placing a piece of camphor in a solution already made is equally good.—*Year Book of Pharmacy.*

**The Sun's Ocean of Light.**—When the sun is viewed through powerful telescopes, its surface—that is, the luminous envelope of the mass—is seen to have a peculiar mottled or curdy appearance. Arago proposed that this envelope should be called the Photosphere, a name now generally adopted. By the elder Herschel, the surface of this photosphere was compared to mother-of-pearl. Other astronomers have said that it resembles the ocean on a tranquil summer day, when its surface is slightly crisped by a gentle breeze, and an undulating play of light is reflected from these little billows. Irregular lines of light are sent back from the crests of the small waves, and lines of shadow indicate the hollows. Within the last few years Mr. Nasmyth has discovered a more remarkable condition than any that had previously been suspected. Examining the solar surface with a fine telescope of great penetrating power, this astronomer has discovered objects which are peculiarly lens-shaped. He himself describes them as more like "willow leaves" than anything else; but some other observers, since their discovery, have likened them to rice grains, and others, again, to some forms of Diatomaceæ. These leaved forms are different in size; they are not arranged in any order; they lie crossing each other in all directions; and they have an irregular motion amongst themselves. They are, says Mr. Nasmyth, "arranged without any approach to symmetrical order in the details, but rather (if the term may be used) in a sort of regular random scattering." They are seen approaching to and receding from each other, and sometimes assuming new angular positions, so that the appearance, resulting from the combination of simultaneous motions amongst those forms, has been compared to a dense shoal of fish, which, indeed, they resemble in shape. The size of those objects gives a grand idea of the gigantic scale upon which physical operations are carried out in the sun. They cannot be less than a thousand miles in length, and from two to three hundred miles in breadth. The most probable conjecture which has been offered respecting those leaf or lens-like objects, is that the photosphere is an immense ocean of gaseous matter in a state of intense incandescence, and that they are perspective projections of the sheets of flame. Whatever they may be, it is evident they are the immediate sources of solar heat and light.—*Popular Science Review.*

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

*Grease.*—There is a chapter on the subject in Richardson and Watts' Technology, Vol. 1, Part III., No. 2.

*Erratum.*—No. 270, p. 51, for 31061-8066 read 31695 7210.



SCIENTIFIC AND ANALYTICAL  
CHEMISTRY.

*On a New Re-agent for the Separation of Calcium from Magnesium, by EDWARD SONSTADT, Esq.*

WHEN, in the ordinary course of qualitative analysis, carbonate of ammonium is used to separate calcium from magnesium, unless the former is present in notable proportion to the latter, a very insoluble double carbonate of magnesium and ammonium always accompanies the carbonate of calcium, if this is allowed sufficient time to form. If much magnesium and no calcium is present, the magnesium precipitate still falls after a while. Both metals are precipitated by this reagent, the only difference being that the calcium precipitate forms somewhat earlier than the magnesium precipitate. This fact is cursorily mentioned by Fresenius, more fully by Gmelin, and has recently been made the subject of special notice by Dr. Dyer. Calcium, therefore, can only be separated from magnesium by this re-agent by fractional precipitation, which necessarily involves loss of substance; and, in qualitative examination, the method is sure to mislead when the proportion of calcium present is small, unless it is controlled by other methods. The same remarks apply in substance to the two other methods of precipitation by sulphuric acid and alcohol, and by oxalate of ammonium. When a moderately strong solution of Epsom salts is treated with sulphuric acid and alcohol, the solution is mostly converted into a crystalline magma; and if it is desired to separate a small proportion of calcium, which we will suppose to be present, the magma must be filtered, dissolved, and subjected to the treatment again and again to separate the sulphate of calcium, when, if the quantity of that salt present be very minute, it must be wholly lost. Of course these remarks do not apply to solutions of calcium and magnesium salts containing much of the former, except in a modified degree. What is true of the sulphuric acid and alcohol process is true in a more extended sense of the oxalate of ammonium process. I have precipitated within a trace the whole of the magnesium present in a considerable quantity of solution of chloride of magnesium, simply by successive additions of oxalate of ammonium,—the solution being concentrated to its original bulk after the last addition of the re-agent. Yet, in working with this re-agent, the rule is, that enough of it must always be added to transform all the magnesium salt into oxalate, since oxalate of calcium is soluble in solution of chloride of magnesium. That some magnesium salt must precipitate with the lime salt under such conditions is obvious; and that it does so is well known, and is, though incompletely, provided for by the process being directed to be repeated upon the precipitate first obtained. This process, therefore, is also one of fractional precipitation, and for it to approach success, the operator must know pretty nearly beforehand how much calcium, in proportion to the magnesium present, he has to deal with. Nevertheless, it is unquestionable that in skilled hands, either of the two last processes is capable of giving close approximations to the truth, when the quantity of calcium present amounts to a few per cent. of the mixed salts. When the quantity of calcium is less than 1 per cent., I do not think it is possible to estimate it accurately by any of these processes; and when the proportion is larger, the processes are at least more troublesome, have a wider limit of experimental error, and are more apt to fail in less experienced hands than the analytical processes in

use for estimating most of the other commonly occurring elements.

In common tungstate of sodium we possess a test for calcium which is probably equal in delicacy and in certainty to that of chlorine for silver, or of sulphuric acid for barium.

The action of this test, in a preliminary examination, requires to be ascertained—

- (1.) With calcium solutions alone.
- (2.) The presence of magnesium.
- (3.) The presence of magnesium and ammonium salts, and of these with free ammonia.

**(1.) The Behaviour of Tungstate of Sodium with Solutions of Calcium Salts.**—A saturated solution of sulphate of calcium, taken at 13° C. remains perfectly clear on addition of an equal volume of a saturated solution of tungstate of soda for a short time. On warming, when the solution attains the temperature of 42° C., it becomes turbid, deposits a film upon the containing glass vessel, and soon after a dense precipitate falls. To ascertain the limit of the action of the test, the solution of sulphate of calcium was successively diluted to various degrees, and precipitates obtained, until the solution was so dilute that it contained but one part of sulphate of calcium in 114,000 parts water. A few drops of solution of tungstate of sodium were added, the solution warmed, and at 56° C., the solution became distinctly opalescent. An experiment was then made on the distilled water used for the dilution, but it gave no reaction. It was evident that it was possible to push the attenuation much further, and yet get indications of calcium. But this proportion ( $\frac{1}{114000}$ ) is near the limit at which sulphate of calcium may be rendered distinctly visible. A solution of chloride of calcium behaves similarly. Sulphate of magnesium is not precipitated by tungstate of sodium, unless the solutions of the two salts are strong. The experiments were made with a solution of pure sulphate of magnesium, of specific gravity 1.114, and containing 11.283 per cent. of the anhydrous salt. The solution of tungstate of sodium was saturated (at common temperature), and contained about one-third its weight of dry salt. A mixture of equal parts of these solutions gave no precipitate in the cold, but quickly crystallised when warmed, the crystals being difficultly soluble, and leaving a very slight residue of an insoluble variety of tungstic acid, or of some compound of that acid. But when the mixed solutions above described were very little diluted, the solution remained perfectly clear at any temperature, until the fluid was concentrated by evaporation, when no precipitate, but clear crystals, appeared. It is only, therefore, in very concentrated solutions that tungstate of sodium gives—not then a precipitate—but crystals, with sulphate of magnesium. The chloride of magnesium solution behaves similarly, though it was not so closely examined.

**(2.) The Behaviour of Tungstate of Sodium with Solutions containing Calcium and Magnesium.**—The earlier experiments seemed to indicate that the presence of magnesium did not at all interfere with the precipitation of the calcium. But on continually diminishing the quantity of the calcium salt while that of the magnesium salt was kept constant, it was found that the latter exercised a very appreciable solvent power. The limiting experiment was as follows:—To 5 cc. of a solution containing 7 parts in 100,000 of sulphate of calcium were added 3 cc. solution of sulphate of magnesium, containing 11.283 per cent. anhydrous salt, 12 cc. water, and a few drops of tungstate of



sodium. There were thus, in 2,000,000 parts of fluid, 35 parts sulphate of calcium, and 33,849 parts sulphate of magnesium—the remainder being water, except the small quantity of tungstate of sodium. The reaction was not visible till the fluid reached the temperature of 70° C., when it became apparent, and, on putting it aside to cool, a perfectly distinct film formed on the glass. A similarly attenuated solution of the lime salt, but containing no magnesium, was exposed to the same conditions with the re-agent, and the reaction in the latter case occurred earlier, at a lower temperature, and was more distinct. Nevertheless, the fact remains that, in a mixed solution of the sulphates of calcium and magnesium, the presence of the former may be clearly detected up to the proportion of about 1 part in 56,000 of fluid containing about 1000 parts of magnesium salt. Rougher experiments made with the corresponding chlorides led to similar results.

(3.) The influence of ammonium salts in obstructing the precipitation of calcium in presence of magnesium is very marked. A calcium salt, in presence of a very large proportion of both magnesium and ammonium salts, cannot be certainly recognised except somewhere near  $\frac{1}{4000}$ th of the calcium salt be present in solution. The influence of free ammonia with sulphate of ammonium and sulphate of magnesium, in like large proportions, is so great as to only just admit of the recognition of the calcium when from  $\frac{1}{600}$ th to  $\frac{1}{1000}$ th is present. Nevertheless, enough, and rather more than enough, ammoniacal salt may be present to prevent any precipitation of magnesium by excess of ammonia, and a moderate excess of ammonia may also be present, without sensibly affecting the estimation of the lime in a quantitative experiment. Chloride of ammonium does not dissolve the precipitate when it is once formed.

The analytical experiments on weighed mixtures of calcium and magnesium salts, imperatively necessary in introducing a new re-agent, are not yet completed, most of the experiments of this kind made till now having been vitiated through ignorance of the conditions necessary to ensure success. I give, however, the results of one experiment, the conditions of which approached more nearly to those I now know of as being necessary than the others, reserving the series, together with the methods adopted for obtaining pure materials to work with, for a second paper.

	Taken.	Found.
Magnesia . . . . .	0.3097 grms.	0.3120
Carbonate of calcium . . . . .	0.0043	0.0042

The weighed quantities of carbonate of calcium and of magnesium were dissolved in a slight excess of hydrochloric acid; neutralised carefully by ammonia, precipitated by tungstate of sodium, and then the filtrate, with the usual precautions, by common phosphate of sodium. The excess in the weight of pyro-phosphate of magnesium led to the suspicion that some tungstic acid had been carried down—a suspicion amply confirmed by the colouration obtained from the solution of the ignited precipitate in dilute hydrochloric acid when treated with tin.

A little in anticipation of my intended future paper upon the subject, I now add such details respecting the manipulation required in separating lime from magnesia by tungstate of sodium as my experience has shown to be necessary. It is convenient to have the solution of the magnesium and calcium salts made somewhat alkaline by ammonia, but a very large quantity of this, as well as of ammoniacal salt, is, as we have seen, to be avoided. The beaker in which the precipitation is to be

effected should, while perfectly dry and warm, be rubbed within by chamois leather on which a drop or two of fine oil (such as is used for oiling balances) has been put. If this precaution be not taken, it will be found impossible to detach the precipitate of tungstate of calcium from the sides and bottom of the vessel. A considerable excess of the re-agent is not necessary; but, if it occur, is not material. If, on addition of the re-agent, a white, flocculent precipitate forms immediately, it is well to add a few drops of ammonia, when the flocculent precipitate will re-dissolve; but if it does not re-dissolve, after warming, there is some other element present, which, if ordinary Epsom salts are used, will probably be manganese. The tungstate of calcium precipitate is very dense; it forms slowly in very dilute solutions, and, in all cases, several hours should be allowed for it to form. The solution should be warmed meanwhile, but must not be allowed to boil. The precipitate must be washed till the filtrate shows no cloudiness on standing with nitrate of silver, when the salts are chlorides; or if they are sulphates, till chloride of barium gives no cloudiness. The precipitate must then be further washed with dilute solution of ammonia, but these washings need not be saved. The filter should be burnt separately, after the precipitate is cleared from it as nearly as possible. After the ignited precipitate is weighed, a little strong solution of ammonia should be poured upon it, and allowed to stand for awhile, when the ammonia is decanted, and supersaturated with acid. If a precipitate falls after a time, the tungstate of calcium precipitate should (without being removed from the crucible) be allowed to stand for some hours with more ammonia—it is then washed by decantation, again ignited, and weighed. The ignited precipitate should be perfectly white.

The filtrate, containing the magnesium salt and tungstate of sodium, may be at once precipitated by phosphate of sodium in the usual way; but if this is done, much washing is required to get rid of the little tungstic acid that adheres obstinately to the precipitate. It is better, especially when a great excess of the re-agent has been used, to first precipitate the tungstic acid by a considerable excess of hydrochloric acid, and boil until the precipitate becomes dense and intensely yellow. The solution is then filtered, supersaturated with ammonia, and the magnesia precipitated in the usual way; but, even in this case, it is better to wash lastly with stronger ammonia solution than ordinary.

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*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

PART I.

EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(Continued from page 86.)

**Berzelius's Atomic Weights and Notation.**—

The important researches of this Swedish chemist on equivalents and atomic weights date from almost the same period as do those of Dalton. In 1807, whilst he was preparing the first edition of his *Traité de Chimie*, he happened to read Richter's forgotten work, and called the attention of chemists to the laws which govern the composition of salts.

Richter had stated that for the same class of salts



there existed a constant relation between the proportion of acid and the amount of oxygen in the base. Berzelius confirmed this statement, and put it in a simpler form by proving that for the same class of salts there existed an uniform and simple relation between the amount of oxygen in the acid and of oxygen in the base. Thus he showed that in neutral sulphates this proportion was as 3 to 1, in nitrates as 5 to 1, and in neutral carbonates as 2 to 1.

Here the principal achievement is less, perhaps, in propounding a law than in the superiority of the analyses. Bergmann had made several analyses, and Wenzel had made some tolerably exact ones, but no one had yet arrived at the same degree of accuracy as did Berzelius, the father of our modern analytical processes. He commenced his works in 1808, and in 1815 he was enabled to give a table of atomic weights based upon his own determinations, and much more accurate than those of his predecessors. He compared the atomic weights with that of oxygen, which he called 100; that of hydrogen was 6.24. The influence of Gay-Lussac's discoveries on fixing the atomic weights is here clearly shown. In fact, the ratio of the atomic weights, 100 to 6.24, or 16 to 1, is that of their densities. Wollaston had given for the *equivalents* of hydrogen and oxygen numbers which were not very different from those of Dalton. These numbers, which represented the proportions by weight according to which oxygen combines with hydrogen, are true equivalents, whilst Berzelius's numbers, which express the proportions by weight which exist between equal volumes of hydrogen and oxygen, are true atomic weights. But this distinction is shown still more clearly in the chemical notation which Berzelius brought into use. Dalton represented the composition of water by the symbol  $\odot \circ$ , in which  $\odot$  represented one atom of hydrogen and  $\circ$  one atom of oxygen. Berzelius expressed this composition by the formula  $H_2O$ , in which  $H_2$  represented two atoms of hydrogen and  $O$  one atom of oxygen. He also made use of an abridged notation. Thus the formula of water was written  $\text{H}\dot{\text{O}}$ , the letter  $\text{H}$  representing two atoms of hydrogen and the dot one atom of oxygen. Moreover, Berzelius attached a particular meaning to these barred symbols; they represented what he termed double atoms. According to him, two atoms of hydrogen  $\text{H}\dot{\text{H}}$  or two atoms of chlorine  $\text{Cl}\dot{\text{Cl}}$  were looked upon as inseparable as they entered together into combination. Thus, one double atom of hydrogen (two atoms) entered into combination with one single atom of oxygen. One double atom of hydrogen entered into combination with one double atom of chlorine. Berzelius wrote the formula of water  $\text{H}\dot{\text{H}}\text{O}$ ; that of hydrochloric acid  $\text{H}\dot{\text{H}}\text{Cl} = \text{H}_2\text{Cl}_2$ ; that of ammonia  $\text{N}\dot{\text{H}}_3 = \text{N}_2\text{H}_6$ ; that of chloride of calcium  $\text{Ca}\dot{\text{Cl}} = \text{CaCl}_2$ . In certain cases, therefore, the double atoms represented the quantities which entered into combination—that is to say, the equivalents. The idea of double atoms is not now adopted in the sense in which Berzelius used it. But it is necessary to observe one thing, which is, that having taken as unity one atom of oxygen, he admitted that the atoms of hydrogen, chlorine, nitrogen, phosphorus, arsenic, &c., only represented half an equivalent, and that it was necessary to take a double atom (or two atoms) of these bodies to make one equivalent. This conclusion was perfectly logical. In the tables which the illustrious Swedish chemist gave there are seen, besides the simple atomic weights, certain double atomic weights, which represent the proportions according to which bodies enter into

combination or their equivalents. These are the numbers given by Berzelius:—

	Atomic Weights.		Equivalents.	
	Symbols		Symbols	
Oxygen	O	100	O	100
Hydrogen	H	6.24	H	12.48
Nitrogen	N	87.53	N	175.06
Fluorine	Fl	117.717	F	235.435
Chlorine	Cl	221.64	Cl	443.28
Bromine	Br	499.81	Br	999.62
Iodine	I	792.996	I	1585.992
Sulphur	S	200.75	S	200.75
Selenium	Se	495.285	Se	495.285
Tellurium	Te	801.76	Te	801.76
Phosphorus	P	196.0205	P	392.041
Arsenic	As	469.40	As	938.80
Carbon	C	75.12	C	75.12
Boron	Bo	136.204	Bo	136.204
Silicium	Si	277.778	Si	277.778
Potassium	K	488.856	K	488.856
Sodium	Na	289.729	Na	289.729
Lithium	Li	81.66	Li	81.66
Calcium	Ca	251.651	Ca	251.651
Barium	Ba	855.29	Ba	855.29
Strontium	Sr	545.929	Sr	545.929
Magnesium	Mg	158.14	Mg	158.14
Aluminium	Al	170.90	Al	341.80
Glucium	Gl	87.124	Gl	174.248
Zirconium	Zr	419.728	Zr	839.456
Manganese	Mn	344.684	Mn	344.684
Chromium	Cr	328.87	Cr	328.87
Uranium	U	742.875	U	742.875
Iron	Fe	350.527	Fe	350.527
Cobalt	Co	368.65	Co	368.65
Nickel	Ni	369.33	Ni	369.33
Zinc	Zn	406.591	Zn	406.591
Cadmium	Cd	696.767	Cd	696.767
Copper	Cu	395.60	Cu	395.60
Lead	Pb	1294.645	Pb	1294.645
Bismuth	Bi	1330.377	Bi	2660.754
Tin	Sn	735.294	Sn	735.294
Titanium	Ti	301.55	Ti	301.55
Tungsten	W	1188.36	W	1188.36
Molybdenum	Mo	596.10	Mo	596.10
Antimony	Sb	806.452	Sb	1612.903
Mercury	Hg	1251.29	Hg	1251.29
Silver	Ag	1349.66	Ag	1349.66
Rhodium	R	651.692	R	1303.384
Palladium	Pd	665.477	Pd	665.477
Platinum	Pt	1232.08	Pt	1232.08
Iridium	Ir	1232.08	Ir	1232.08
Osmium	Os	1242.624	Os	1242.624
Gold	Au	1129.165	Au	2458.33*

The principles which guided Berzelius in the determination of the atomic weights are simple, and his processes are exact. He varied the latter and controlled them by one another. He thus learnt, as he modestly said,† to discover the faults that he had at first committed, and at last had the satisfaction of finding an

\* The numbers here given are not those which appeared in the first tables of Berzelius. We have thought it best to give the atomic weights which he finally adopted, and we have extracted them from the last German edition of his great work (Appendix to vol. iii. "Tabulæ Atomicae"). Amongst the equivalents of the metals, it will be remarked that those of aluminium, glucium, bismuth, antimony, rhodium, and gold are double their atomic weights. Berzelius supposed that the combination of these bodies contained at least two atoms of metal. Thus he wrote— $\text{AlO}_3$ ,  $\text{AlCl}_3$ ,  $\text{BiO}_3$ ,  $\text{BiCl}_3$ ,  $\text{SbO}_3$ ,  $\text{SbCl}_3$ ,  $\text{RCl}$  (protochloride of rhodium),  $\text{AuCl}$  (protochloride of gold),  $\text{AuCl}_3$ , &c. It is seen that in all these compounds the amount of metal which enters into combination (improperly termed its equivalent) is represented by two atoms.

† *Lehrbuch der Chemie*, 1845, iii., 1160.



accurate agreement between the results of analysis and theoretical calculations.

In general he considered the atomic weight of a metal to be the quantity of this metal which combined with 100 of oxygen to enter into the first degree of oxidation. He deviated from this rule, however, in certain cases.

Thus he considered that the atomic weights of copper and of mercury are represented by the amounts of these metals which combine with 100 of oxygen to arrive at the second degree of oxidation. Since 1826† he represented the composition of the oxides of copper and mercury by the formulæ

$\text{Cu}_2\text{O}$ ,	$\text{CuO}$ ;	$\text{Hg}_2\text{O}$ ,	$\text{HgO}$ .
Cuprous oxide.	Cupric oxide.	Mercurous oxide.	Mercuric oxide.

Amongst the reasons which led him to deviate from the rule given above may be given two which possess considerable importance.

In 1819 and 1820 were announced two great discoveries which have exercised a marked influence over the development of the atomic theory.

The first according to date is that of Dulong and Petit, concerning the relations which exist between the specific heat of simple bodies and their atomic weights; the second, which is due to Mitscherlich, is that of isomorphism.

(To be continued.)

#### *The Influence of Lodes on Rocks,* § by R. PEARCE, Esq.

It is a fact well known to most miners that the granite which is found near lodes is frequently different, both in composition and general character, from the granite which is met with at some distance from the lodes. To be convinced of this fact, we have only to observe the granite in the quarries at the summit of Carn Marth, and compare it with a sample of rock from the base of the hill near Wheal Damsel. Many other districts in Cornwall offer fine examples of these rock changes. The conditions are not the same in every district; the various kinds of alterations being effected perhaps by local causes. If we observe carefully the joints in granite quarries, we find that the walls of these joints are often coated with crystals of schorl, and the felspar of the granite near the joints is sometimes replaced by this mineral, or much discoloured from the presence of oxide of iron; showing that these small fissures are sufficient in many cases to produce a number of important changes both in the composition and general appearance of the granite. It is found, too, that the direction of the joints materially affects the characters of the mineralogical changes which take place; thus, for example, in the quarry at Carn Marth, the joints having a bearing about 25 deg. S. of W., contained amethyst, fluor spar, and chlorite; whilst in those joints having a direction 10 deg. W. of N. nothing but schorl and oxide of iron could be detected. At Trelubbas quarry, Wendron, this was still more strikingly shown; the joints having a bearing 20 deg. S. of W. were found to contain chlorite, copper pyrites, white mundic, and blende; while, on the other hand, those which had a contrary direction were perfectly free from those minerals, and contained nothing but schorl and oxide of iron. In the St. Just district precisely analogous conditions may be found. These mineralogical changes may be seen, however, on a much larger scale in granite and elvan when found in close

proximity to mineral lodes. Take, for example, the mining districts of St. Just, St. Ives, Wendron, Redruth, Gwennap, and Liskeard, and we find that although there may be a difference in the mineralogical character of these changes, yet there is no difficulty in tracing their origin to the effect of mineral lodes. There is no doubt but that similar changes may be found in our stratified rocks, but these do not offer the same advantages for observation as the crystalline rocks which I have named—granite and elvan.

One of the most common forms of these alterations is the change of one or more of the constituents of granite (felspar, quartz, and mica) into chlorite; this may be observed in almost every metalliferous district in the county where granite occurs. The mineral which is most commonly metamorphosed is felspar, as it appears to be less capable of resisting the solvent action of water than the other minerals—quartz and mica. It is not common, however, to find well-formed pseudomorphs of chlorite after felspar. I have observed them recently in the granite near Carn Marth, and also in an elvan course at the Consolidated Mines, Gwennap.

My attention was first directed to this elvan course by Mr. Enys, who had noticed some of its peculiar characters for a long time. It appears to have undergone a series of very interesting changes. The first alteration appears to be the conversion of the amorphous felspar into quartz, leaving the crystalline felspar intact; the next change is the substitution of the crystalline felspar by chlorite. It is very evident that the crystalline felspar is extremely liable to alteration, for we find that simple exposure to atmospheric influences is sufficient to cause it to disintegrate and change into kaolin or china clay. In one or two instances Mr. Saltren Rogers and myself have observed that the replacement of the felspar by chlorite has commenced in the centre of the crystal. These changes may be seen in all their stages in the elvan rocks on the surface, at the afore-mentioned mine. The replacement of felspar in granite by chlorite is well shown in the mining districts of Gwennap, Camborne, and Redruth, St. Ives, and also in the Caradon Mines; and there are strong evidences of the formation of lodes by the alteration of the granite. I have seen tin lodes near St. Austell which consist of altered granite (schorl, quartz, mica, and oxide of tin). The tin lodes in many of the St. Just mines exhibit satisfactory proofs of having been formed by the metamorphism of the granite in which they occur. Examples of this kind may be seen also at Dolcoath and many other mines.

The above facts would lead us to believe that there is a relation between the natural joints of rocks and mineral lodes; for we have strong grounds for supposing that many of the lodes in Cornwall and elsewhere have been formed by the infiltration of water (containing in solution the various minerals) through the natural joints, producing in its passage the changes which are seen. The discovery of copper and associated minerals at Trelubbas quarry in the joints having a direction 10 to 20 N. of E. and S. of W. (whilst those minerals were entirely absent in the joints running in a contrary direction) indicates that these minerals are deposited in the joints having about the same direction as the principal lodes of Cornwall. The lodes which are seen at Priest's Cove, St. Just, in the granite, have all been formed in the natural joints of that rock.

Schorl, fluor spar, oxide of tin, and iron pyrites, are found sometimes replacing one or more of the ordinary constituents of granite and elvan. Pseudomorphs of oxide of tin after felspar have been met with in the

† In 1815 he took for certain metals double the atomic weights that he adopted later; thus, at this period he wrote:

$\text{FeO}_2$ ,	$\text{FeO}_3$ ;	$\text{CuO}$ ,	$\text{CuO}_2$ ;
Ferrous oxide.	Ferric oxide.	Cuprous oxide.	Cupric oxide.
$\text{HgO}$ ,	$\text{HgO}_2$ ;	$\text{PbO}_2$ ;	$\text{AgO}_2$ , &c.
Mercurous oxide.	Mercuric oxide.	Plumbic oxide.	Argentite oxide.

§ A paper read before the Cornwall and Devon Miners' Association.



elvan course at Wheal Coates (St. Agnes), and in the granite at Balleswidden Mine, St. Just; it has been found replacing the felspar in the granite near the foot wall of the lode at Phoenix, and also at Dolcoath, but in this instance the quartz of the granite has been substituted by this mineral.

The replacement of felspar by schorl is of very common occurrence; it is not only seen in districts where mineral lodes abound, but occurs frequently at the junction of the granite with the slate. On the north side of Cape Cornwall, where these rocks join, may be seen huge blocks of granite, the felspar of which has been partly, and sometimes entirely, replaced by schorl; the same change may be seen at St. Ives, and also in the parish of St. Ender. At the latter place perfect pseudomorphs of schorl after felspar may be found; the felspar has been converted into china clay, which occurs in large quantities in the district. I have observed some interesting pseudomorphs of schorl after felspar in an elvan course at Poldice. The presence of iron pyrites in granite is of great interest. I have observed it recently in the Wendron district, near Wheal Trumpet and Old Wheal Mount mines; the mundic occurs in isolated cubes diffused equally throughout the rock, but only in close proximity to the lodes.

I think we must either ascribe the existence of this mineral in the granite to the influence of the lodes passing through it, producing this metamorphism, or discard the theory of its igneous origin; because it is well known that bisulphide of iron (iron pyrites) cannot exist at the temperature of fused granite. From the peculiar character of the rock, and its relation to the lodes, I should certainly be inclined to adopt the former opinion. The crystals of mundic, on exposure to the atmosphere, become converted into pseudomorphs of red oxide of iron.

It is difficult to account for the various changes which I have named. It is, however, evident that water plays the chief part; and probably the substances produced by the destruction of one mineral reunite to form the mineral which takes its place. If we compare the chemical composition of felspar with chlorite, we find that the only difference is, the substitution of potash and a portion of the silica of the felspar, by magnesia, oxide of iron, and water. We find that the water which circulates through the fissures and joints of rocks frequently contains both these substances (oxide of iron and magnesia) in solution, and we also know that felspar is a mineral which under certain circumstances is readily decomposed, yielding up its potash, so that there is little difficulty in accounting for the change of felspar into chlorite; heat would also very materially assist in bringing about these changes. At the Clifford Mines, Gwenap, where we find the elvan metamorphism so well shown, the temperature of the water coming from the lode is very high (it registered a few months since 125°). This, I have no doubt, accounts in a great measure for the rapid decay and repair to which the rock has been subjected. I have every reason to believe (after a number of careful observations) that the capel of lodes has been formed from the decay of minerals which enter into the composition of the rocks adjoining. A number of careful analyses of capel from districts, would, I have no doubt, greatly assist in explaining this point.

The facts which I have noticed in this paper may appear to have little practical bearing in a mining point of view. I am convinced, however, that the subject is an important one, and, if diligently investigated, must assist in explaining some of the laws which regulate mineral deposits.

*On the Separation of Chromium from Aluminium, Iron, Manganese, Cobalt, Nickel, Zinc, and Magnesium, by WOLCOT GIBBS, M.D., Rumford Professor in Harvard University.*

SESQUIOXIDE of chromium in an alkaline solution is readily oxidised to chromic acid by means of chlorine, bromine, or deutoxide of lead. When chlorine or bromine are employed as oxidising agents, the alkaline solution may be neutralised by acetic acid after the oxidation is complete, and the chromic acid may then be precipitated by acetate of barium, when the solution is free from sulphuric acid, and directly weighed in the form of chromate of barium. In place of free alkali, it will be found in practice very much more convenient to employ acetate of sodium or potassium. When a solution of sesquioxide of chromium is rendered nearly neutral by a solution of carbonate of sodium, and acetate of sodium is added in excess, a current of chlorine gas, or a solution of chlorine water, readily converts the whole of the chromium present into chromic acid, especially when the solution is hot, and when it is kept nearly neutral by occasional addition of carbonate of sodium. The excess of chlorine is easily expelled by boiling. After which, in the presence of bases not precipitated by ammonia, the chromic acid may be precipitated by acetate of lead, or acetate of barium, and weighed in the form of chromate—provided, of course, that no sulphuric acid is present. When sulphate and chromate of barium are thrown down together, the chromic acid may be reduced to sesquioxide by boiling with concentrated chlorhydric acid and alcohol, after which the barium may be precipitated by sulphuric acid, and the sesquioxide of chromium thrown down in the filtrate by boiling with ammonia in the usual manner. As the reduction of chromate of barium by means of chlorhydric acid and alcohol does not take place very readily, it is better to boil the chromate with an excess of carbonate of potassium or sodium, to filter off the carbonate of barium, and determine the chromic acid by means of nitrate of suboxide of mercury, or by reduction to oxide of chromium and precipitation with ammonia in the usual manner.

When aluminum and iron are to be separated from chromium by this process, the two oxides may be precipitated together by simply boiling the solution after the complete oxidation of the chromium to chromic acid, in the presence of excess of acetate of sodium. It is more convenient and equally accurate to neutralise the solution with ammonia, separate the alumina and sesquioxide of iron by filtration, and determine the chromium in the filtrate by reduction and precipitation with ammonia.

When the oxide of calcium, magnesium, zinc, nickel, cobalt, and manganese are present in a solution containing sesquichloride of chromium, it is best to oxidise the chromium to chromic acid as above, and then to precipitate with acetate of lead or barium.

I have stated in a former paper that chromic iron ore may be completely resolved by fusion with fluohydrate of fluoride of potassium. In this and in all similar applications of the fluohydrate it is best to evaporate the finely-pulverised mineral to dryness with a concentrated solution of the salt. On subsequently heating to low redness, the resolution of the mineral is effected with the utmost ease, a portion of the chromium being usually oxidised to chromic acid by the oxygen of the air. After expelling the fluorine by heating the fused mass with sulphuric acid, the remaining mass may be treated with acetate of sodium and chlorine in the manner already pointed out, the iron and aluminium separated by boil-



ing, and the chromic and sulphuric acids precipitated by acetate of barium, after which the chromium may be determined as above.

In precipitating chromic acid by means of nitrate of suboxide of mercury, hot solutions must not be employed, as a small portion of chromic acid is always reduced to sesquioxide of chromium. The precipitated chromate should be allowed to stand some hours before filtering. In general the precipitation by acetate of lead or acetate of barium is to be preferred even when the resulting chromate is to be weighed as such.—*American Journal of Science and Art*, January, 1865.

*On the Employment of Acetate of Sodium for the Separation of Iron and Aluminium from other Bases,*  
by WOLCOT GIBBS, M.D., Rumford Professor in Harvard University.

THE facility with which iron and aluminium are precipitated from neutral solutions of the sesquioxide by boiling with acetate of potassium or sodium has led to frequent analytical applications, though the method is not so generally employed as it deserves. Mr. C. F. Atkinson has devoted much time to a careful study of the subject, and has arrived at the following results, which appear to me worthy of attention:—

The sesquioxides of iron and aluminium may be perfectly separated from the protoxides of manganese, cobalt, nickel, zinc, magnesium, and calcium, and from sesquioxide of uranium, by boiling the neutral or nearly neutral solutions with acetate of sodium, provided that the following precautions are observed:—The solutions from which the sesquioxides are to be precipitated must be dilute; half a litre of the solution should not contain more than one grain of either sesquioxide or of the two, when both are present. The quantity of acetate of sodium should be sufficient to convert by double decomposition all the bases present into neutral acetates. The acetate should be added to the metallic solution when cold, and the whole should then be heated together and boiled for a short time. It is not necessary to filter upon a water-bath funnel, but the beaker containing the solution should be kept nearly at the boiling point during filtration, and a ribbed filter should be employed. In all cases it is best to add a few drops of free acetic acid to the solution, to prevent the formation of basic acetates of the protoxides. This is especially necessary in separating iron and aluminium from zinc and nickel.

Finally, it is best, whenever possible, to have all the bases present in the form of chlorides. The iron and alumina upon the filter in the form of basic acetates must, whenever an absolutely complete separation is necessary, be re-dissolved in chlorhydric acid, and again be precipitated by boiling with the acetate after rendering the solutions nearly neutral by means of carbonate of sodium. In this manner only it is possible to separate the last traces of the stronger bases. Finally, the basic salts of the iron and aluminium, after washing, must be re-dissolved in chlorhydric acid, and precipitated by boiling with ammonia in the usual manner, to free them completely from alkali. The precaution of a second treatment with acetate of sodium is more necessary with alumina than with sesquioxide of iron alone. It is scarcely worth the trouble in the separation of iron from calcium and magnesium.

According to my own observations the sesquioxides of iron and aluminium cannot be separated from sesquioxide of chromium by boiling with acetate of sodium, although the last-mentioned oxide is not precipitated

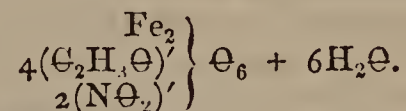
when alone in solution. In this case it is necessary to oxidise the chromium to chromic acid by chlorine in the manner already pointed out.—*American Journal of Science and Art*, January, 1865.

## TECHNICAL CHEMISTRY.

*Analysis of an Iron Mordant,\* by M. A. SCHEURER-KESTNER.*

I HAVE in a former note described the composition of an iron mordant employed to dye plush black. This mordant contained ferric oxide, acetic and nitric acids, and chlorine.†

I have since analysed another mordant, serving equally well for dyeing plush, and which is free from hydrochloric acid and chlorine. The solution as sold is of a dark brown colour, with a strong odour of acetic acid. When evaporated, if boiled too quickly it decomposes, and deposits ferric hydrate; but if properly and carefully evaporated, it gives a beautiful crystallisation of ferric diacetate containing nitric and acetic acids. When the evaporation has been properly effected, most of the solution can be transformed into crystals, which have on analysis given the numbers leading to the formula of ferric tetraceto-dinitrate—



## PHOTOGRAPHY.

*Chloride of Gold.‡*

AT a time when so many complaints are being made by photographers of the impurity of the chloride of gold they employ, some details may be useful on the fabrication of this valuable product. Ordinary chloride of gold (perchloride of gold  $\text{Au}_2\text{Cl}_3$ ) is obtained by dissolving gold in aqua regia, a mixture of one part of nitric acid and four parts of hydrochloric acid. By evaporating gently, crystals are produced of hydrochlorate of chloride of gold ( $\text{Au}_2\text{Cl}_3 + \text{HCl}$ ). It is this salt, containing an excess of acid, which is often sold as chloride of gold. It is in the form of a light yellow crystal, while perchloride of gold, anhydrous and quite pure, is of a red-brown colour. If it is further heated to eliminate the acid, a brown mass is the result, but part of the perchloride is transformed into protochloride insoluble in water,  $\text{Au}_2\text{Cl}$ . We have thus either an acid salt or a considerable loss of gold. Pure perchloride of gold, decomposed at a high temperature, ought to give thirty-four centigrammes of pure gold for one gramme of salt. This result is never obtained with commercial perchloride, which, as we have said, contains either acid or water in excess, and is sometimes even adulterated with chloride of sodium; the latter is, however, easily recognised. By heating a little chloride of gold in a porcelain capsule, and, after cooling, pouring on it two or three drops of pure distilled water, and then heating slightly, a liquid is obtained, which, evaporated on a platinum plate, should leave no residue; and with which a drop of water and one of nitrate of silver ought to give no precipitate.

The great difficulty of producing this salt in a neutral and pure state has induced M. Fordos to propose the employment of double chlorides of gold and potassium

\* *Bulletin de la Société Chimique*, 1864, ii.

† *Repertoire de Chimie appliquée*, p. 470, 1863.

‡ *Bulletin de la Société Chimique*.



or gold and sodium, which are easily obtained, and are used in the same proportion as perchloride of gold.

To prepare double chloride of gold and potassium ( $\text{Au}_2\text{Cl}_3 \cdot \text{KCl} + 5\text{HO}$ ), dissolve one gramme of gold in one gramme of nitric acid, and four grammes of hydrochloric acid. Evaporate to crystallisation, dilute with a little distilled water, and add 0.51 gr. of bicarbonate of potash; evaporate to dryness to expel the excess of acid; dissolve in a little distilled water; filter through asbestos; and crystallise by evaporation.

To prepare double chloride of gold and sodium ( $\text{Au}_2\text{Cl}_3 \cdot \text{NaCl} + 4\text{HO}$ ), instead of 0.51 gr. of bicarbonate of potash, use 0.73 gr. of pure carbonate of soda.

#### *Positives without Salts of Silver—M. Liesegang's Process with Ammoniacal Citrate of Uranium\*.*

M. LIESEGANG has for some time been endeavouring to substitute salts of uranium for salts of silver, and has succeeded in finding an extremely simple and certain process, giving, he says, superior results. He uses an ammoniacal uranium salt prepared in the following manner:—

Pour ammonia into a solution of nitrate of uranium, and a precipitate of uranate of ammonia will be formed, which must be carefully washed in distilled water, to get rid of every trace of nitric acid. Then dissolve it in citric acid.

Mix this solution of citrate of uranium and a little solution of chloride of gold with a paste prepared by dissolving tapioca powder in hot water. The quantity of chloride of gold must be small, and the heat not too great, otherwise the gold will be reduced.

Spread this mixture with a sponge on paper, which takes a brilliant yellow colour, similar to albumenised paper; when quite dried in the dark, place it in the positive frame. The proofs have all the force and delicacy of those obtained with albumenised paper; the preparation is very sensitive, and becomes more so if slightly moistened.

The proofs come from the frame in a proper state, and of a bluish black colour; they should not be toned, and should be fixed by being washed with rain water until the yellow colour of the paper completely disappears. The picture may be changed to purple by a solution of chloride of tin.

## PROCEEDINGS OF SOCIETIES.

### ACADEMY OF SCIENCES.

February 20, 1865.

FATHER SECCHI made a communication "*On the Influence of the Atmosphere on the Lines of the Spectrum, and on the Constitution of the Sun.*" Further observations with a more perfect spectroscope have confirmed the opinion before published by the Reverend Father that the atmospheric lines are due to aqueous vapour. With regard to the constitution of the sun, he observes that the principal things seen on looking at it through Mr. De la Rue's eye-piece is that the luminous base of the sun is seen as a net work, over which a great number of white points are visible more or less elongated and separated by darker meshes, the knots of which appear to be small black holes; the white bodies, to which the shadows of the solar spots give a peculiar appearance, the author regards as masses of luminous clouds which certainly cannot be composed of aqueous vapour.

\* *Moniteur de la Photographie.*

The commission appointed to review the experiments of M. Pasteur and his opponents, MM. Pouchet, Mussel, and others, relative to the question of "*Spontaneous Generation*" brought up a report. It was entirely in favour of M. Pasteur, and therefore opposed to the theory or facts of spontaneous generation. The report establishes that fermentable liquors may remain either in contact with confined air, or exposed to air which is often renewed without changing; and that if changes do take place, and organic beings are generated, this result cannot be attributed to the gaseous elements, but must be caused by solid particles introduced with air, and of which it may be completely deprived. Some of the experiments were objected to by the supporters of heterogenesis, and the commission will make further researches when warmer weather arrives.

M. Tresca, whose experiments of the flow of solid bodies (soft metals and ceramic pastes) from a small aperture when submitted to great pressure we have noticed before, has now extended his researches to ice. This body is found to issue in exactly the same way as the solids above mentioned. The jet is formed of perfectly distinct concentric tubes, which, however, in this case are grooved through their entire length with transverse fissures which gave to the jet the appearance of being made up of washers arranged one after another. The results support strongly Dr. Tyndall's theory of constitution of glaciers. Some effects resembling *moraines* were, indeed, seen when coloured ice was employed in the experiments.

M. Persoz read an abstract of a memoir "*On the Molecular State of Bodies, introductory to a General Theory of Compounds of Organic Origin.*" This work, which ought soon to be published at length, our readers will see is of great importance, since the author gives, among many other things, the peculiar characters which distinguish, in a molecular point of view, the bodies which polarise light from those which do not; the compounds which serve as alimentary matters from those which are not nutritious; the poisonous alkaloids from those which are innoxious; and lastly the carbon products, the radicals of which are the bases of colouring matters, natural or artificial." The author also applied to have a sealed packet opened which he deposited two years ago. It contained a description of *new (?) method of taking the specific gravity of solids.* It is as follows:—A known weight P of the body, the density of which is desired, is introduced into a flask of known capacity, V, full of air. The volume of the body will be given by that of the air displaced; so fill up the flask with water, or, of course, some other proper liquid, and measure carefully the quantity required. The volume required, v, subtracted from V, will give the volume of the body, and the density will be—

$$D = \frac{P}{V - v}$$

M. Chancel has studied the action of *Gypsum on Wines*, and has come to the following conclusions:—

1. That the gypsum takes into the wine in the shape of tartrate of lime half the tartaric acid which would otherwise remain in the marc.
2. That it increases the acidity of the wine, brightens the colour, and insures keeping.
3. That it introduces to the wine in the state of sulphate the greater part of the potash which would be found in the marc in the state of bitartrate.

A letter from Dr. Jackson to M. Elie de Beaumont described an apparently inexhaustible deposit of emery in the State of Massachusetts, much superior to that of Naxos.

### CHEMICAL SOCIETY OF PARIS.

January 27.

M. CLOEZ, on presenting to the Society a small publication on the use of iodide of potassium as a test for ozone, took



the opportunity of replying to a statement of Kosmann, that ozone was exhaled from plants. M. Cloez detailed some experiments he made ten years ago which satisfied him that the oxygen given off by plants is without action on ioduretted paper, and consequently not ozonized.

A communication by M. Jodin was read, "*On the Changes which take place in Vegetable Tissues under the Influence of Air and Light.*" A memoir by Kekulé, "*On the Constitution of Aromatic Substances,*" and a paper by Lieben, "*On Abnormal Vapour Densities,*" were also read.

## NOTICES OF BOOKS.

*The Philosophy of Health; or an Exposition of the Physiological and Sanitary Condition Conducive to Human Longevity and Happiness.* By SOUTHWOOD SMITH, M.D. Eleventh edition, revised and enlarged. London: Longman and Co. 1864.

DR. SOUTHWOOD SMITH was the Physician of the Utilitarian School. While Bentham and Mill concerned themselves with laws and morals as they influenced the well-being of a community, he recognised the great fact that sound health was at the bottom of individual happiness, and that to ensure "the greatest happiness of the greatest number" the first thing to do was to ensure them, as far as possible, healthy bodies. Seeing, too, that the conditions under which the mass of the population lived (and live) were not such as conduced to the healthy performance of bodily functions, he became a sanitary reformer. Knowing, also, that an acquaintance with the construction and operations of a machine are of the first importance to its proper regulation, he wrote his "*Philosophy of Health,*" a popular manual of anatomy and physiology, and sought to disseminate among the people a knowledge of the principles upon which alone sound health can be maintained.

To a certain extent he was successful. The book in its earlier and cheaper form had a very large circulation. Towards the close of his useful life the author occupied himself with revising and extending the work—a task of no little labour when the advance made in our knowledge of physiology since the first publication is considered. Unfortunately he did not live to complete his task, and the work has been given to the world by a relative, who has not pointed out how far the author's revisal extended. Criticism is thereby disarmed, or we might point out places in which the best sources of information have been neglected.

This, however, will not interfere with the usefulness of the book as a popular guide. Its great recommendation is its *readableness*. Dr. Smith could make even the dry details of the bony structure of the body pleasant reading, and on this account alone we may strongly recommend the book to all who, without wishing to become professed anatomists, are yet anxious to have some acquaintance with the marvellous structure they inhabit. The anatomical part is now, indeed, the chief feature of the work, and with the assistance of the plates, introduced from Gray's Anatomy, a respectable knowledge of the subject may be gained by its perusal.

Physiological chemistry was in its infancy when Dr. Smith first wrote his book, and but little has been added on the subject in this edition.

The author's ideas of the power of chemistry to unveil the secrets of nature were limited, as will be seen by the following quotation:—

"So complete are the analyses which have led to the discovery of the facts now stated, that there is scarcely anything to be desired with respect to the knowledge of the ultimate composition of organic matter. Yet chemistry, which has so admirably displayed its analysis, has wholly failed to accomplish its synthesis. The chemist can analyse organic matter, but he cannot make it; not even a particle

of sugar, the substance which stands on the very confines of the inorganic world. The plant can make it, so can the insect, but not the chemist. Some few of the binary inorganic compounds he has separated into their elements, and then by again combining them he has reproduced the substance he has decomposed. . . . But he cannot so recombine the elements of sugar or gum, of albumen or fibrin; yet he knows the exact proportions in which the elements unite to produce these substances, and he witnesses their actual transformation in every leaf that grows, in every flower that blooms; but the subtler process by which the change is effected he knows not and cannot imitate.

"He cannot do this because he cannot command, and does not even know, the conditions on which the formation of these substances depend. The chemistry by which these are generated is doubtless the same in its essential nature as that by which the crystal is produced; but organic substances, as already stated, can only be formed under conditions peculiar to life, and these conditions appear to be placed beyond human control and forbidden to human knowledge."

There is truth here, although the illustration is not well chosen. We may despair of ever seeing a granule starch produced by a chemist, but we have some hopes that the synthesis of sugar may one day be effected.

*The Irrationale of Speech.* By A MINUTE PHILOSOPHER. London: Longman and Co. 1864.

THIS is a reprint of a very clever article which appeared some years ago in *Fraser's Magazine*. It is written in undisguised advocacy of Dr. Hunt's method of curing stammering, but is none the less well worth reading. The writer appears to have benefited under the system, and we hope his words now flow as freely from his mouth as his thoughts from his pen, and in that case his conversation must be worth listening to.

*The Ophthalmic Review, &c.* Edited by J. ZACHARIAH LAURENCE and THOMAS WINDSOR. Hardwicke. No. 4. January, 1865.

THE present number of this Review worthily sustains the reputation acquired by the earlier numbers. It contains papers by Graefe, Liebreich, and Dr. Mackenzie, and the first part of a long and able review, or abstract it may be called, of Donders' great book "*On the Anomalies of Accommodation and Refraction,*" together with several practical articles of much interest to advanced ophthalmologists.

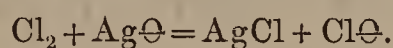
*Annalen der Chemie und der Pharmacie.* December, 1864.

THIS journal reaches us very late, which is not of much importance, since we have met before with nearly all the articles it contains. Among the novelties we notice a paper by Wehrhane and Hübner on "*Cyanide of Phosphorus.*" They prepare this body by heating together in a sealed tube a mixture of cyanide of silver and chloride of phosphorus. The mixture must be made in a strong tube, which is kept well cooled; the addition of a little chloroform or ether delays the reaction. After the tube is sealed it is heated to 130° or 140° for six or eight hours, and the contents are then distilled in a stream of dry carbonic acid. Long needles and thick tabular crystals of cyanide of phosphorus condense in the neck, and when cold may be detached by the aid of a glass rod. The cyanide must be quite cold, otherwise it is apt to take fire in the air. An analysis showed the composition to be  $3\text{CN}, \text{P}$ . The crystals inflame when touched with a warm glass rod. In moist air they gradually decompose, with separation of phosphorus, phosphorous acid, and formation of cyanic acid. They are but little soluble in chloroform, ether,



bisulphide of carbon, and chloride of phosphorus. In water they are decomposed into cyanic and phosphorous acids. Cyanide of phosphorus is also produced by the action of pentachloride of phosphorus on cyanide of silver. The authors also tried the reaction of chloride of phosphorus and sulphocyanide of silver, and the chlorides of antimony and arsenic on cyanide of silver, but obtained no definite results.

J. Schiel communicates "*A Curious Lecture Experiment.*" He places some peroxide of silver in a test-tube, draws it out in the middle, and seals it. He then places it in a stoppered bottle, which he fills with well dried chlorine, then shakes the bottle and breaks the test-tube. The chlorine immediately attacks the peroxide of silver, and in a few seconds the bottle is filled with colourless oxygen. When oxide of silver is used, the colour change does not take place so rapidly. Equivalent amounts of chlorine and the peroxide must be used. The peroxide is prepared by passing a stream of ozonised oxygen (from a Siemen's tube with a strong induction apparatus) over dried oxide of silver, which must be stirred occasionally with a platinum wire. The author expects to prepare hypochlorous oxide  $\text{ClO}$  in a similar way by using two equivalents of chlorine to one of oxide of silver—



*Zeitschrift für Chemie, &c.* Nos. 1 and 2, 1865.

In these two numbers the new editors have laid English and American journals under contribution, and as yet we see no signs of the improvements and extensions promised by Dr. Hübner. Acrolein seems to be a body much studied in Germany, for we have here two papers, one by Genther, "*On the Chlorinated Derivatives of Acrolein,*" and another by Dr. Aronstein, "*On some Compounds from Acrolein.*" The latter has studied the action of alcoholate of potassium and sodium on chloride of acrolein, of bromine and chlorine on acrolein, and has decided that cyanogen has no action beyond resinifying the acrolein after long passing. He has also studied the behaviour of acrolein towards the chlorides of acetyl and benzoyl. An abstract of an inaugural dissertation by Karl Birnbaum gives an account of some *bromine compounds of iridium*. Bromide of iridium may be found by passing the vapour of bromine over iridium heated to redness, either alone or mixed with bromide of sodium; it is a blue compound. The author also describes some double bromides of iridium, and the alkaline metals, and ammonia. All the other papers of interest in the two journals have been noticed before.

## NOTICES OF PATENTS.

1452. *Calcining and Smelting Copper Ores.* P. and J. B. SPENCE, Newton Heath. Dated June 11, 1864.

1506. *Smelting Copper Ore.* P. SPENCE, Smedley New Hall, and H. D. POCHIN, Broughton Old Hall, near Manchester. Dated June 17, 1864.

THESE patents refer to improved modes of conducting the calcination and smelting of sulphuretted copper ores, whereby the sulphur is economised and the process of reduction effected with a considerable saving of fuel. The calciner instead of being placed independently of the smelting furnace, is connected with it, and the ore is first submitted to the action of heat in a part of the apparatus which may be described as being a prolongation of the flue of the smelting furnace; when the operation of roasting is completed, the ore is raked forward to the smelting hearth, and there mixed with the aluminous flux which forms the subject of the second patent. The sulphurous acid vapours which escape throughout the operation are conducted into a leaden chamber, and are there converted into sulphuric acid. The flux is described as being the

insoluble residuum remaining after the action of sulphuric acid upon the shale of the coal measures used in the manufacture of alum.

1435. *Welding Steel and Cast or Malleable Iron.* C. W. CORSAN, Sheffield. Dated June 9, 1864. (Not proceeded with.)

THE inventor employs in the welding process, instead of sand alone, a mixture composed of borax fifty parts, Calais sand thirty parts, manganese and emery, of each ten parts.

1453. *Treating Mixed Fabric Rags containing Vegetable and Animal Fibre.* G. RYDILL, Dewsbury. Dated June 11, 1864. (Not proceeded with.)

IN separating cotton and woollen fibres when contained in a variety of white and coloured mixed fabrics, or rags of the same, the inventor acts upon the materials with nitric acid, or the same diluted with water, by which the cotton is destroyed, and the black or other dye upon the woollen fibres at the same time discharged.

1498. *Manufacture and Utilisation of Carbonic Acid.* G. H. OZOUR, Paris. Dated June 16, 1864.

THE patentee describes a variety of processes which are applicable to the manufacture of the carbonates, and in the preparation of effervescing wines and aqueous beverages.

1509. *Manufacture of Leys or Liquors Applicable to the Cleansing and Bleaching of Wool, &c.* J. H. JOHNSON, Lincoln's Inn Fields, London. A communication. Dated June 17, 1864.

FOR the cleansing and bleaching of silk, wool, cotton, and other fibrous substances, as well as of textile fabrics, the inventor employs an alkaline ley or solution of sulphide of sodium in combination with the carbonate and silicate of soda, or the first-named agent in admixture with aluminate of potash or soda, or other alkaline salts possessed of detergent properties.

The use of alkaline sulphides for these purposes commonly imparts a dark colour to vegetable and animal fibres, on account of their containing appreciable traces of oxide of iron. An after treatment with dilute acid, or even prolonged exposure to air, would greatly improve the appearance of the goods, by dissolving out or inducing the oxidation of the ferrous sulphide.

## GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

297. T. Routledge, Sunderland, "Improvements in treating spent or used leys resulting from the preparation of fibrous substances used in the manufacture of paper stock."—Petition recorded Feb. 2, 1865.

301. B. L. Moseley, Sheffield, "A new or improved tooth powder."—Feb. 3, 1865.

306. J. R. Webb, Hibernia Chambers, London Bridge, "A new or improved method, or process and apparatus, for obtaining the concentrated extract of hops, and for preserving the same from deterioration." A communication from G. Percy and others, New York, N.S.A.

307. F. Row, Colchester, Essex, "Improvements in the manufacture of citric and tartaric acids, and in the manufacture and treatment of citrate and tartrate of lime and analogous basic compounds, and in apparatus employed therefor."

310. J. A. Phillips, Earl's Court Terrace, Kensington, Middlesex, "Improvements in the purification of lead to be employed for the manufacture of white lead, red lead, and litharge."

311. F. C. Hills, Deptford, Kent, "Improvements in effecting the combustion of fuel in the furnaces of steam-



boilers, and the fire-places of stoves and of gas in gas burners, and in apparatus connected therewith."

313. Edouard Hottin, Rue de la Fidélité, Paris, "Certain improvements in rendering unflammable cotton, silk, and other textile fabrics."

315. R. A. Brooman, Fleet Street, London, "An improved varnish for preserving wood, and for protecting iron ships and other metal work from oxidation and from fouling." A communication from A. Guibert, Paris.

319. R. M. Alloway, Strand, Middlesex, "Improvements in treating or manufacturing peat for fuel, and in apparatus for the same."—Feb. 4, 1865.

339. A. A. Hulot, Imperial Mint, Paris, "A new typographic ink."—Feb. 6, 1865.

340. J. Cornes, Ilford, Essex, and W. Simpson, Rosher-ville, Kent, "Improved machinery for cutting, sifting, separating, bruising, sacking, and preparing straw and other vegetable fibrous substances to be employed in the manufacture of various kinds of paper, and also for preparing food for cattle."—Feb. 7, 1865.

353. R. C. Thorp and P. Young, Barnsley, Yorkshire, "Improvements in the miner's safety lamp."

354. J. Desmoutils, Avenue de la Mothe Piquet, Paris, "Improvements in the manufacture of grease for lubricating purposes."—Feb. 8, 1865.

362. W. A. Marshall, Leadenhall Street, London, "A new or improved insulating material for telegraphic and other purposes, together with an improvement in protecting telegraph wires, especially applicable to submarine and subterranean telegraphs." A communication from J. Erckmann, Paris.

363. J. C. C. Halkett, Cramond Iron Works, Mid Lothian, N.B., "Improvements in protecting wooden surfaces from the fouling and injury to which they are ordinarily liable in sea water."

371. J. Dale, Manchester, "Improvements in the production of substances to be used in place of the pigment usually termed satin white."—Feb. 9, 1865.

374. E. Leigh, Manchester, "Improvements in furnaces for smelting iron ores, commonly called blast furnaces, also in cupolas used in foundries for rendering down or melting iron or other metals."—Feb. 10, 1865.

388. J. Hall, Nottingham, "The manufacture or production of oil for the use of machinery, or for other similar purposes."

391. W. Crookes, F.R.S., Wine Office Court, Fleet Street, London, "Improvements in extracting and separating gold and silver from their ores or matrices."

397. H. H. Grierson and J. M. Rigby, Manchester, "Improvements in cupolas and blast furnaces."—Feb. 11, 1865.

402. L. H. G. Ehrhardt, Richmond Road, Bayswater, "An improved gunpowder."

403. J. A. Pastorelli, Rue Cariol, Marseilles, "Improvements in extracting turpentine and tar from resinous wood."—Feb. 13, 1865.

411. H. J. Walduck and E. Barton, Manchester, "Improvements in furnaces for smelting or reducing ores, and for melting metals."

418. A. Fryer, Manchester, "Improvements in the mode of treating for evaporating and concentrating purposes cane juice, and saccharine and other solutions and liquids, and also in machinery or apparatus for the concentration of cane juice, and saccharine and other solutions, and for the evaporation of liquids."

419. E. H. Newby, Cheapside, London, "Improvements in the manufacture of cast and wrought iron."—A communication from A. L. Fleury, New York, U.S.A.—Feb. 14, 1865.

#### NOTICES TO PROCEED.

2533. W. R. Sykes, Pimlico, Middlesex, "Improvements in apparatus for transmitting positive and negative currents of electricity."

2538. R. Wright, Barge-yard, Bucklersbury, London,

"Improvements in preparing saccharine matters."—Petitions recorded Oct. 14, 1864.

2560. J. Cassell, La Belle Sauvage Yard, London, "Improvements in apparatus for the combustion of gas and atmospheric air." A communication from J. Best, Paris.—Oct. 17, 1864.

2607. A. Reynolds, Bagillt, Flintshire, "An improved mode of manufacturing sulphuric acid."—Oct. 21, 1864.

2656. P. A. Le Comte de Fontaine Moreau, Paris, "An improved composition for uniting iron with wood, and leather with leather; for waterproofing textile fabrics, paper, and cordage; for moulding and for various other purposes." A communication from Lemaistre and Co., Brussels.—Oct. 26, 1864.

2786. W. E. Newton, Chancery Lane, "An improved filter or press." A communication from L. P. R. de Massy and L. R. de Massy, Paris.—Nov. 9, 1864.

2842. M. Henry, Fleet Street, London, "Improvements in the means of or appliances for treating bodily injuries, affections, and disorders when atmospheric air is to be excluded from the part affected." A communication from Dr. J. Guerin, Paris.—Nov. 14, 1864.

2896. J. Easton, jun., Southwark, "Improved apparatus for the manufacture of paper pulp."—Partly a communication from F. Thiry, Huy, Belgium.—Nov. 19, 1864.

2906. A. V. Newton, Chancery Lane, "Improvements in the manufacture of sugar, and in the machinery to be used therein."—A communication from C. Rosland, Paris.—Nov. 23, 1864.

16. T. J. Ashton, Cavendish Square, "An improved portable pneumatic apparatus, applicable in surgery and medicine for all purposes, as a douche for affusion, irrigation, injection, and for enemas."—Jan. 3, 1865.

93. A. G. Loek, Millbrook, Hampshire, "Improvements in extracting and purifying fats and other products from bones and other animal substances, and in apparatus for the same."—Jan. 11, 1865.

156. S. F. Van Choate, New York, U.S.A., "An improved system and apparatus for facilitating the working of submarine cables and other conductors of electricity."—Jan. 19, 1865.

209. W. Woodward, R. Woodward, J. Woodward, and A. Woodward, Manchester, "Improvements in furnaces for melting metals and smelting ores."—Jan. 24, 1865.

## CORRESPONDENCE.

### Continental Science.

PARIS, February 28.

MANY in England will learn with regret the news of the sudden decease of M. Gratiolet, the Professor of Zoology at the Sorbonne. He was seized with apoplexy on the 21st, and died in a few hours. As one of our most eloquent lecturers, and as an indefatigable worker, and an original thinker, his loss will be greatly regretted.

We have in the *Moniteur Scientifique* the announcement of a grand chemical school which Signor Cassola has opened at Naples. He has hired a large convent and turned it into a laboratory. Italy did much for alchemy, the great grandfather of chemistry, and monasteries were the homes of science in the middle ages. Let us hope then that Signor Cassola's establishment will flourish and produce abundant fruits.

M. Tellier is still busy with his ammoniacal horses. I am not aware that he has actually started one yet, but he has started a new idea. He thinks ammonia is the very thing to drive a carriage either over or through Mount Cenis. If you go through the mountain there will be no combustion to contaminate the air in that dreadfully long tunnel. If you go over, you may adapt the motive



machinery to every carriage, or indeed to every pair of wheels, and thus multiply the points of contact so that there will be no difficulty in getting up the steepest ascents. And when you get to the top you have only to turn a tap, put on your break, and you may descend as slowly as you please. All this looks so simple that I am very anxious to see one of M. Tellier's vehicles started.

An icicle is an exceedingly pretty object, and it is a great pity that it only to be seen under circumstances of personal discomfort. The sight of one in summer would be very refreshing. In the absence of reality, a good imitation is worth looking at; but most imitations are execrably bad, mere conical impositions, which it is easy to see that Nature had no hand in making. So, I suppose, thought M. Millot-Brulé as he looked one frosty morning lately at some beautiful objects which hung from a weir; and he carefully broke them off, took plaster of Paris moulds of them, and now makes casts which he says form beautiful ornaments for aquaria, fish basins, and other objects.

M. Jules Faure mentions a scientific curiosity, which I am inclined to think new. If, he says, you put a crystal of sulphate of copper or sulphate of iron into a very dilute solution of silicate of potash, a sort of mineral vegetation grows up of the same colour as the sulphate. You may, in fact, obtain a miniature forest at the bottom of a jar, and by placing the crystal on the top of a layer of well-washed sand coloured with a little bichromate of potash, you may appear to have an artificial soil greatly resembling a natural gravelly deposit. The misfortune is that you cannot move the vessel, for a slight shake will destroy all the beauty of the appearance.

M. Lallemand, of Versailles, has found that the light of magnesium is sufficiently active to determine the combination of hydrogen and chlorine. He effects the explosion with the light from a single wire burnt in a spirit lamp.

An ingenious clockmaker of Versailles has invented a clock, no larger than the ordinary instruments, which will go for a year, or indeed for a much longer time. The internal mechanism is not altered, but the pendulum is replaced by a horizontal lever, which acts on a twist of elastic wire suspended vertically.

M. Liandier has been a diligent observer of shooting stars for the last three years, and he asserts without fear of contradiction that all meteors which leave no trail are going in the same direction as the atmospheric wave in the upper regions of the air, while those which do leave a trail are going in an opposite direction.

The French Government has tried Dr. Morgan's method of preserving entire sheep and oxen, and the results of the experiments have been highly satisfactory. The animals killed and injected last August have been eaten recently, and the meat was found to be excellent—especially the beef-steaks, say the reporters. I should hope this process will soon be in use in South America; I know it will be in Australia. The South American Beef Company should look to it.

You will have heard, probably, that the French Government has laid a tax on telegraphic dispatches. Caselli's autographic apparatus is in use, and the tax is laid on the surface of paper employed, 20 centimes per square centimetre. This would be an awful tax in England, where people usually write a much larger hand than they do here. The Administration sells sheets of paper of different dimensions, 30, 60, 90, and 120 square centimetres for the dispatch to be written upon, but they charge 10 centimes for all sizes.

The journals here made a mistake which I copied some time ago when making mention of a mechanical leech, invented by Dr. Damoiseau. It was said that this instrument would extract 60 grammes of blood a minute, but the Doctor now writes to say that it will draw as much as 120 grammes in that time, which is equal to the result

obtained by 600 leeches sucking at once. That would be terrible; the instrument is named *a téradelle*.

We have had a long patent trial here. It began in 1859, and the matter in dispute was a patent for "lichen dyes" (French purple), which was taken out by M. Frezon on August 14, 1848, and who had brought an action against MM. Guinon and Marnas for infringement. The Court decided against the patentee on the ground that Dr. Stenhouse's paper communicated to the Royal Society on February 3, 1848, was a previous publication of a process substantially the same, and producing the same result, and therefore M. Frezon's patent was invalid.

I think I have before mentioned a method of preserving bodies devised by Signor Gorini. The Academy of Sciences of Turin have given the method a trial, and report it satisfactory. A body is preserved fresh in a fit state for dissection for six months or more. It gradually hardens, however, and becomes a sort of mummy, which resists decay for an indefinite period of time, but which can again be made soft and supple by soaking in water. After this discovery there need never be a lack of subjects in our dissecting-rooms. In times of plenty we may preserve and bury the bodies, and take them up again as wanted.

#### *On a Phenomenon occasionally observed in the Determination of Moisture.*

To the Editor of the CHEMICAL NEWS.

SIR,—In the determination of moisture for commercial purposes it is frequently the custom, previously to weighing the dried substance, to place the watch glass containing it in contact with the hand, in order to ascertain whether it has completely cooled. In so doing a considerable electrical excitement will be occasionally observed among the particles on the watch glass, sometimes of sufficient violence to cause them to be projected from its surface, and thus to render the determination worthless. This phenomenon, which is not very visible with most substances, is best seen in light bodies in a state of fine division—powdered animal charcoal, for instance, and is probably owing to the fact that, however carefully we apply the hand to the bottom of the watch glass, it is almost impossible to avoid a certain amount of friction and the consequent electrical excitement. It need scarcely be said that by actually rubbing the hand beneath the watch glass a very considerable portion of its contents may be thrown out, and also that the excitement (in which, except for its appearance under the peculiar circumstances above detailed, there is, of course, nothing remarkable) decreases rapidly by a brief exposure to a moist atmosphere.

I have now observed this phenomenon from time to time for at least seven years, and if the contents of this note should appear to you to possess any novelty, I would feel obliged by its being published in your valuable journal.

I am, &c.

JOHN A. R. NEWLANDS, F.C.S.

Laboratory, 19, Great St. Helens, E.C., Feb. 27.

#### MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Monday, March 6, at 2 o'clock, General Monthly Meeting; at 3 o'clock, Professor Tyndall, "On Electricity." Tuesday and Thursday, March 7 and 9, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Friday, March 10, at 8 o'clock, Professor Ramsay, F.R.S., "On the Eozoon," (or earliest known fossil). Saturday, March 11, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

**Wholesale and Export Drug Company (Limited).**—The directors announce that they are enabled to close the share list of this Company for allotment or



shares, for London on Saturday, March 11, and for the country on Monday, March 13. They also state that the warehouse and business arrangements of the Company will be placed under the management of Mr. William Charity, who has held a similar position for the last fourteen years with the eminent firm of Messrs. Barron, Harveys, and Co., wholesale druggists.

**"Our Inheritance in the Great Pyramid."**—

In the concluding paragraph of our notice of this work it was stated that Professor C. P. Smyth was about to proceed to Egypt to ascertain for himself the accuracy of certain measurements relating to the Great Pyramid of Jizeh, and we further informed our readers of the author's intention of testing the employment of the magnesium light as a means of illuminating the interior, and photographing the most interesting features of this wonderful monument of ancient art.\* We have now the satisfaction of announcing the safe arrival of Professor Smyth and his party, and of reporting the progress made by him during the first three weeks of his residence. Mr. Spiller has favoured us with the following extract from a letter which he has lately received from Professor Smyth:—

"East Tomb, Great Pyramid, Feb. 2, 1865.

"My dear Sir,—We are settled down at last to the measuring; the chief part of the time hitherto (about three weeks) having been occupied in concert with a party of labourers furnished by the Egyptian Government in clearing away rubbish from important parts of the interior, and in cleansing and preparing it for nice observation.

"The magnesium wire light is something astounding in its power of illuminating difficult places. With any number of wax candles which we have yet taken into either the king's chamber or the grand gallery, the impression left on the mind is merely seeing the candles and whatever is very close to them; so that you have small idea whether you are in a palace or a cottage; but burn a triple strand of magnesium wire, and in a moment you see the whole apartment and appreciate the grandeur of its size and the beauty of its proportions. This effect, so admirably complete, too, as it is, and perfect in its way, probably results from the extraordinary intensity of the light, apart from its useful photographic property; for side by side with the magnesium light the wax candle flame looked not much brighter than the red granite of the walls of the room. There come parties—often many parties—of visitors to see the Pyramid every day, and they come amply provided, too, with all sorts of means and appliances to enjoy the sight—i.e., with everything but the needful magnesium wire; and one waistcoat pocket full of that would be worth a whole donkey load of what they do bring up to enable their souls to realise the ancient glories of the internal scene.

"Whatever can be reached by hand is chipped, and hammered, and fractured to a frightful degree; and this maltreatment by modern man, combined with the natural wear and tear of some of the softer stones under so huge a pressure as they are exposed to, and for so long duration, has made the measuring of what is excessively tedious and difficult, and the concluding what was, in some cases, rather ambiguous. The temperature, of which I am glad to find you like the idea, is one of these, and I am accumulating observations upon it as it is and on the anomalous conditions accompanying:

"I remain yours very truly,

"C. PIAZZI SMYTH.

"John Spiller, Esq., Chemical Department,  
Royal Arsenal, Woolwich."

**The Use of Sewage.**—Baron Liebig has addressed another letter to the Lord Mayor in strong condemnation of Messrs. Hope and Napier's Maplin Sands' scheme. "The project of Messrs. Napier and Hope," he says, "is one of the most curious. It is, in the fullest sense of the

word, baseless, for the land to be experimented upon does not as yet exist. All the calculations, therefore, as to crops, returns, and percentage of capital are absolutely fabulous. It seems to me like a soap-bubble, glistening with bright colours, but inside hollow and empty; there is not the slightest doubt that every penny expended upon that frivolous undertaking would be irretrievably lost. The carrying out of this scheme would not only be a squandering of an enormous amount of money, but before long would also be looked on as a national calamity." The Baron argues the impossibility of making sand fertile, and appears to us to take into too little account the undissolved ingredients of London sewage.

**Homicide by Imprudence.**—That is a verdict which brought a fine of 50 francs and eight days' imprisonment upon Madame Roy, who deals in drugs and groceries, and in the course of her business sold 50 grammes of nitre in mistake for seidlitz powder, and so caused the death of Madame Helie. It is a curious feature in the French law that a grocer may sell drugs, but not in medicinal doses, a regulation which seems to afford no protection to life.

**Liquor Potassæ as a Solvent for Gum Resins.**—Solutions of gum resins in liq. potassæ recommend themselves for their elegance and economy, while they are generally very effective. For instance, a dilute solution of ammoniacum in water is perfectly clear, whereas a tincture produces an opaque mixture. The alkaline solutions of aloes, catechu, and kino are very cheap and elegant colouring matters, a few drops giving a deep tint to half a pint of water. The quantity of liq. potassæ best adapted for each gum resin will be found to be as follows:—

Aloes . . .	1 part to 15 liq. potassæ.
Ammoniacum . .	1 " 4 "
Assafoetida . .	1 " 10 "
Catechu . . .	1 " 10 "
Guaiaicum . . .	1 " 7 "
Myrrh. . . .	1 " 5 "
Opium . . . .	1 " 10 "

—Year Book of Pharmacy.

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

J. W. will see that the error was corrected last week.

B. was answered last week under the initial "C."

F.—Yes; all are liable.

W. J. Morgan.—Mr. Baillière, Regent Street, will give you the information.

P. W.—Pure zinc for the purpose can be obtained at most operative chemists.

A Long Subscriber.—Oil is most easily extracted from engineer's waste, &c., by means of sulphide of carbon, which can be distilled from the oil without much loss and used again.

The Superior of St. Joseph's.—We have not been able to find a description of Clark's polarising apparatus. Faraday, "On the Non-metallic Elements," was published by Longman and Co. If the publishers should not have a copy, the book may often be met with second-hand.

Self-taught.—1. Most works on chemistry contain tables of French weights and measures, with their English equivalents, and by the help of these, and knowing the specific gravity, you can arrive at the desired results by a rule of three sum. 2. We do not see what our correspondent wishes to know. The calculations quoted appear to be correct.

Books Received.—"Zeitschrift für Chemie;" received regularly from the Editor. "Richardson and Watts' Chemical Technology;" new volume; Baillière. "For and Against Tobacco," by Dr. B. W. Richardson; Churchill and Sons. "The Spirit of Nursing," by Harry Jones, M.A.; Hardwicke.

Received.—J. S. Blockey,



## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

### PART I.

#### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

##### SECTION I.—*Historical Development of the Ideas, Equivalent, Atom, Molecule.*

(Continued from page 100.)

**Law of Specific Heats.**—Dulong and Petit have shown that the specific heat of simple bodies is in inverse ratio to their atomic weights, in such a manner that if the two quantities are multiplied together the product is constant.

This is equivalent to saying that the atoms of simple bodies, so different from each other in their relative weights, possess evidently the same specific heat. This is an unexpected result, which may be regarded as a striking confirmation of the atomic hypothesis:—

The following are the results obtained by Dulong and Petit:—

Simple bodies.	Specific heat.	Atomic weight.	Product of atomic weights by the specific heat.
Sulphur.	0.1880	201.15	0.3790
Gold	0.0298	1243.0	0.3704
Platinum	0.0314	1215.2	0.3816
Tin	0.0514	735.3	0.3779
Bismuth	0.0288	1330.4	0.3835
Copper	0.0949	395.7	0.3755
Lead	0.0293	1294.5	0.3793
Zinc	0.0927	403.2	0.3738
Nickel	0.1035	369.7	0.3826
Iron	0.1100	339.2	0.3731

Some few exceptions to the law of specific heats have been observed. Among the simple bodies experimented on by Dulong and Petit, arsenic, antimony, silver, tellurium, and cobalt have not shown this remarkable relation between the atomic weights and the specific heats. But these exceptions may be attributed, on the one part, to our ignorance of the real atomic weights, and on the other to errors in the determination of the specific heat—errors which the classical researches of M. Regnault have since entirely overcome. We will return to this subject.

In order to appreciate the assistance rendered at that time by the law of specific heat to the atomic theory, it is enough to remark that in the case of copper and of some other metals it has helped to make the true series of oxidation of these metals known, and to decide in favour of the atomic weights which have been generally adopted.\* Thus the atomic weight of copper compared with that of oxygen (100) is not 791.4, but 395.7, a number which agrees with the law of specific heats.

**Isomorphism.**—The grand discovery of Mitscherlich has rendered similar service. It may be thus explained. Bodies composed of an equal number of atoms arranged in the same manner crystallise in forms identical, or almost so. The resemblance of the exterior forms results from the similitude of their atomic structure; and isomorphous bodies offer this remarkable peculiarity, that they can mix in indefinite proportions in the crystals without the form being sensibly changed.

But it is a necessary consequence of this law that whenever two bodies are really isomorphous they possess similar atomic structure. Their composition ought then to be expressed by analogous formulæ. Sulphate of copper and sulphate of iron can mix when crystallised together, and the form of these crystals remains that of sulphate of iron whenever the proportion of sulphate of copper is less than  $\frac{1.9}{2.0}$ . These mixed crystals contain seven molecules of water, like crystals of green vitriol. If, on the contrary, the proportion of sulphate of copper exceeds  $\frac{1.9}{2.0}$ , the mixed salt takes the form of blue vitriol (unsymmetrical prisms), and like it contains five molecules of water. These two vitriols, which can crystallise together, must then possess the same atomic structure, and if green vitriol contains one atom of iron, blue vitriol ought to contain one atom of copper. It follows, therefore, that oxide of iron and oxide of copper each contain one atom of metal and one atom of oxygen, and we must take for the atomic weight of copper the quantity of this metal which combines with one atom of oxygen (100 of oxygen) to form the second oxide of copper—that is to say, cupric oxide.

Isomorphism and the law of specific heats agree, then, in the adoption for this oxide of the formula  $\text{CuO}$ , a fact which fixes the atomic weight of copper. We know, on the other hand, that the two oxides in question are isomorphous with the protoxides of nickel, cobalt, and manganese, oxide of zinc, and magnesia. All these oxides possess the same atomic composition. The following is another example:—Iron alum and ordinary alum will crystallise together, and whatever be the proportions of the mixture the form of the crystals is always that of a regular octahedron. The double sulphate of alumina and potash is thus isomorphous with the sulphate of iron and potash. The two sulphates and the two oxides should therefore possess the same atomic composition, and if ferric oxide contains two atoms of iron and three atoms of oxygen, alumina must be composed of two atoms of aluminium and three atoms of oxygen.

Such is the assistance that the law of isomorphism affords in the construction of formulæ and the determination of atomic weights.

**Equivalent Notation.**—The discoveries of Gay-Lussac, of Dulong and Petit, and of Mitscherlich proved to be a strong confirmation of Dalton's ideas, and the enormous labours of Berzelius had given a solid basis to them. For twenty years the system of atomic weights and notation of the great Swedish chemist were paramount in science, owing to the legitimate and incontestable authority of his name. Nevertheless, some objections were raised against this notation, and the idea of double atoms met with a certain amount of opposition. Why should we admit, said Gmelin,† that the equivalents of hydrogen, chlorine, bromine, nitrogen, &c., are formed of double atoms, when the simple atoms of these bodies do not in reality exist in any combination? An atom is the smallest quantity of a body which enters into combination. The equivalents of the preceding bodies represent, therefore, their atoms, and it will be much better to take for their atomic weights numbers double those which Berzelius has given in conformity with the theory of volumes. The formulæ of water, of hydrochloric acid, and of ammonia, become therefore  $\text{HO}$ ,  $\text{HCl}$ ,  $\text{NH}_2$ .

To raise these objections was to revive afresh the ideas of Dalton and Wollaston; it was in reality making a step backward, for no importance was attached to the discoveries of Gay-Lussac, and, in consequence, this nota-

\* Berzelius, *Traité de Chimie*, French edition of 1831, iv., 691 (see also the note in CHEM. NEWS, p. 100).

† *Handbuch der Chemie*. Fourth edition. I. 47.



tion by equivalents which was thus inaugurated, finished by acquiring, during the years 1843-1844, the unanimous assent of chemists. The idea of atoms, said they, and atomic notation, are undoubtedly based upon an hypothesis; equivalents represent a reality. Equivalent notation is, therefore, preferable, as it only involves facts.

It was in this manner that the objections raised against the idea of double atoms, which constituted, in fact, the weak part of Berzelius' doctrine, were the cause of the abandonment of atomic notation and the adoption of equivalent notation—a system which is even now employed by many chemists. The equivalents which form the basis of this latter notation are, with few exceptions, those given in the fifth column of the table on page 99, with the exception that it is now considered more convenient to compare them with hydrogen taken as unity.

The following is the table, so modified:—

*Table of the Equivalents of Simple Bodies.*

Aluminium . . .	13.7	Nickel . . .	29.5
Antimony . . .	122	Niobium . . .	48.8
Arsenic . . .	75	Nitrogen . . .	14
Barium . . .	68.5	Osmium . . .	99.6
Bismuth . . .	210	Oxygen . . .	8
Boron . . .	10.9	Palladium . . .	53.3
Bromine . . .	80	Phosphorus . . .	31
Cadmium . . .	56	Platinum . . .	98.7
Calcium . . .	20	Potassium . . .	39.1
Carbon . . .	6	Rhodium . . .	32.2
Cerium . . .	46	Rubidium . . .	85.4
Cæsium . . .	130	Ruthenium . . .	52.2
Chlorine . . .	35.5	Selenium . . .	39.7
Chromium . . .	26.7	Silicium§ . . .	14
Cobalt . . .	29.5	Silver . . .	108
Copper . . .	31.7	Sodium . . .	23
Didymium . . .	48	Sulphur . . .	16
Fluorine . . .	19	Strontium . . .	43.8
Gold . . .	197	Tantalum   . . .	68.8
Glucinum† . . .	4.7	Tellurium . . .	64
Hydrogen . . .	1	Thallium . . .	204
Iodine . . .	127	Thorium¶ . . .	59.6
Iridium . . .	99	Tin . . .	59
Iron . . .	28	Titanium . . .	25
Lanthanum . . .	46.4	Tungsten . . .	92
Lead . . .	103.5	Uranium . . .	60
Lithium . . .	7	Vanadium . . .	68.6
Magnesium . . .	12	Yttrium . . .	?
Manganese . . .	27.5	Zinc . . .	32.6
Mercury . . .	100	Zirconium** . . .	44.8
Molybdenum . . .	48		

It should be remarked that this notation was never applied in a very rigorous manner; and, moreover, the progress of science soon rendered it insufficient, and involved chemists who persevered in its employment in singular inconsistencies.

In the first place, let us observe that the composition of the poly-acid bases, such as alumina or ferric oxide, has almost always been expressed by molecular formulæ and not by equivalent formulæ. It was known that one molecule of alumina would saturate three molecules of sulphuric acid, and this quantity of alumina was wrongly termed an equivalent of alumina. The true equivalent of alumina—that is to say, the quantity of alumina which corresponds to one molecule of potash or of oxide of silver—is the quantity of alumina which contains an equivalent of oxygen. It is this quantity which saturates an equivalent of sulphuric acid. In the notation of equivalents the alumina ought, then, to be represented

by the formula  $\text{Al}_2\text{OSO}_3$ , or  $\text{SAl}_2\text{O}_4$ . Thus wrote Gay-Lussac.†† The general formula used,  $\text{Al}_2\text{O}_3\text{SO}_3$ , did not express an equivalent of sulphate of alumina, but a molecule of sulphate of alumina.

Analogous remarks apply to the poly-basic acids discovered by Mr. Graham, which have clearly defined the notion of poly-atomic molecules. Mr. Graham has shown that common phosphoric acid will saturate three equivalents of a base RO. From that it is evident that one molecule of phosphoric acid saturating three equivalents of oxide of silver cannot correspond to one molecule of acetic acid which only saturates one. The equivalent of phosphoric acid is the quantity of this acid which saturates one equivalent of oxide of silver, and its equivalent formula is therefore  $\frac{1}{3}\text{PO}_5$ . Gay-Lussac, with that rigid accuracy characteristic of his mind, employed such formulæ.

Moreover, Richter was not deceived by this, and the number given in his tables well represents the quantity of this acid which saturates one equivalent of soda in bi-sodic phosphate. (See the note on page 49.)

Should we, then, say that this equivalent notation adopted by Gay-Lussac is preferable to the molecular notation employed by other chemists less scrupulous than he? This must be answered in the affirmative if chemical formulæ only serve to represent equivalents between bodies. But it is not so. Their language is higher and more significant. They are employed to show the complication of molecules, and when they are made use of to depict a reaction, they ought to represent both the bodies which enter and those which are removed—to show, in short, their molecular movements. Equivalent notation is of no use in this respect. It hides very important points in reactions or in the constitution of bodies. When it represents sulphate of alumina by the formula  $\text{Al}_2\text{OSO}_3$ , it does not express the polyacid character of alumina; when it represents phosphate of silver by the formula  $\text{AgO}\frac{1}{3}\text{PO}_5$ , it hides the tribasic nature of phosphoric acid. This is why chemists have instinctively preferred molecular notation to equivalent notation for the salts in question.

It is seen from the above that, after having pointed out a difference between atoms and equivalents, the progress of science leads to the separation of the idea of molecule from that of equivalent of a compound body. Molecules, in fact, are not always equivalent among each other. One molecule of phosphoric acid is not the equivalent of one molecule of acetic acid, and one molecule of alumina is not equivalent to one molecule of oxide of silver.

The distinctions here spoken of were not established in a day. They are ideas which long fermented in chemists' minds before they found expression. The merit of having clearly defined the words atom, equivalent, and molecule belongs principally to Gerhardt, whose researches we will now briefly explain.

(To be continued.)

#### *On the Atomicity of Aluminium, by Professor A. W. WILLIAMSON, F.R.S.*

IN the "Preliminary Note on some Aluminium Compounds," by Messrs. Buckton and Odling,\* some questions of considerable theoretical importance are raised in connexion with the anomalous vapour-densities of aluminium ethyle and aluminium methyle. The authors have

† Oxide of glucinum,  $\text{GlO}$ . § Silicic acid,  $\text{SiO}_2$ .  
|| Tantalum acid,  $\text{TaO}_2$ . ¶ Thorina,  $\text{ThO}$ .  
\*\* Zirconia,  $\text{ZrO}_2$ .

†† *Cours de Chimie*, 1828, 8<sup>e</sup> leçon, page 16.

\* See ante, p. 61.



discovered that the vapour of aluminium methide ( $\text{Al}_2\text{Me}_6$ ) occupies rather more than two volumes ( $\text{H}=1$  vol.) at  $163^\circ$ , when examined by Gay-Lussac's process, under less than atmospheric pressure. The boiling-point of the compound under atmospheric pressure is given at  $130^\circ$ , and the compound accordingly boiled a good deal below  $130^\circ$  at the reduced pressure at which the determination was made. The vapour was, therefore, considerably superheated when found to occupy a little more than two volumes. When still further superheated up to  $220^\circ$  to  $240^\circ$ , it was found to possess a density equivalent to rather less than four volumes at the normal temperature and pressure.

The aluminium ethyle was found to have a density decidedly in excess of the formula  $\text{Al}_2\text{Et}_6 = 4$  vols., but far too small for  $\text{Al}_3\text{Me}_6 = 2$  vols. From their analogy to aluminic chloride,  $\text{Al}_2\text{Cl}_6 = 2$  vols., the methide and ethide might be expected to have vapour-volumes corresponding to  $\text{Al}_2\text{Me}_6 = 2$  vols.,  $\text{Al}_2\text{Et}_6 = 2$  vols. The authors seem, however, more inclined to doubt the truth of the general principles which lead us to consider these hex-atomic formulæ the correct ones, than to doubt their own interpretation of the observations already made upon the new compounds.

Even if the vapour-volume of aluminic chloride had been unknown to us, there were ample grounds for assigning to aluminium methide a molecular formula  $\text{Al}_2\text{Me}_6$ , and a vapour-density corresponding to  $\text{Al}_2\text{Me}_6 = 2$  vols.; for the close analogy of aluminic and ferric salts is perfectly notorious, and the constitution  $\text{Fe}_2\text{O}_3$  for ferric oxide settles  $\text{Al}_2\text{O}_3$  as the formula for alumina. With regard, however, to the chlorides of these metals, it might be supposed that the formula  $\text{FeCl}_3$  and  $\text{AlCl}_3$  would be the most probable molecular formulæ; and Dr. Odling, in his useful "Tables of Formulæ," published in 1864, expressed an opinion in favour of these formulæ by classing as anomalous Deville's vapour-densities, which correspond to the higher formulæ  $\text{Al}_2\text{Cl}_6$ ,  $\text{Fe}_2\text{Cl}_6$ . It is well known that Laurent and Gerhardt, whose penetrating minds raised so many vital questions of chemical philosophy, laid down a preliminary rule that every molecule must contain an even sum of the atoms of chlorine, hydrogen, nitrogen, and metals. According to this rule, the formulæ  $\text{Al}_2\text{Cl}_6$  and  $\text{Fe}_2\text{Cl}_6$  would have no greater probability than the formulæ  $\text{FeCl}_3$ ,  $\text{AlCl}_3$ ; and judging by that rule, Dr. Odling naturally preferred the simpler formulæ.

Since Gerhardt's time chemists have, however, extended to the greater number of metals the arguments which proved oxygen to be biatomic; and we now know that the alkali-metals, the nitrogen series, silver, gold, and boron, may count with the atoms of chlorine, hydrogen, &c. to make up an even number in each molecule, but that the greater number of metals must not be so counted; for that in each molecule in which they are contained the sum of the atoms of chlorine, hydrogen, nitrogen, potassium, &c. must be even, just as much as if the atom of the diatomic or tetratomic metal were not in the compound. In a paper "On the Classification of the Elements in relation to their Atomicities," I had occasion to point out that inasmuch as iron and aluminium belong, partly by their own properties, partly by their analogies, to the class of metals which do not join with chlorine, &c., in making up an even number of atoms, the number of those other atoms in each molecule must be even in itself, just as if iron or aluminium were not there; and that accordingly the formulæ  $\text{Fe}_2\text{Cl}_6$ ,  $\text{Al}_2\text{Cl}_6$  are really quite normal. In like

manner I showed that the vapour-density of calomel,  $\text{HgCl} = 2$  vols., is anomalous, as containing in a molecular volume a single atom of chlorine, although, in accordance with Gerhardt's rule, Dr. Odling had classed it as normal. I certainly understood that my able friend accepted my suggestion in this case at least, for he speedily brought forward theoretical and experimental facts in confirmation of it.

These examples serve to show that it was to be expected that the ethyle and methyle compounds of aluminium would contain an even number of atoms of ethyle and methyle in each molecule, and that their formulæ would accordingly be  $\text{Al}_2\text{Me}_6$ ,  $\text{Al}_2\text{Et}_6$ .

It remains for us to consider how the deviation from our theoretical anticipations in the case of aluminium ethyle and the partial deviation in the case of aluminium methyle ought to be treated.

Fortunately we have the benefit of some experience to guide us in this matter, for a considerable number of other compounds have been found to occupy in the state of vapour nearly double the volume which corresponds to one molecule; but, with very few exceptions, all of them have already been proved to have undergone decomposition, so as to consist of two uncombined molecules. Thus sal-ammoniac is admitted to have the molecular formula  $\text{NH}_4\text{Cl}$ ; yet in the state of vapour this quantity occupies the volume of nearly two molecules—viz., four volumes. Has the anomaly led us to doubt the atomic weight of chlorine, nitrogen, or hydrogen, or to doubt any other of the results of our comparison of their compounds? Or has it led chemists to diffusion experiments with its vapour, proving it to contain uncombined  $\text{HCl}$  and  $\text{NH}_3$ , each occupying its own natural volume? Has it not been proved that at the temperature at which sal-ammoniac vapour was measured, its constituents mix either without evolving heat (that invariable function of chemical action), or, according to another experimentalist, with evolution of far less heat than of the whole quantity of hydrochloric acid and ammonia combined, on coming together at that high temperature?

Again,  $\text{SO}_4\text{H}_2$  is known to represent the formula of one molecule of hydric sulphate, yet the vapour formed from it occupies nearly the bulk of two molecules. Has this fact cast any doubt on the atomic weights of the elements S, O, or H? Or has it led to the discovery of peculiarities in the constitution of the vapour which would probably have escaped notice had they not been anticipated by theory, peculiarities which go a long way towards bringing the apparent anomalies within the law?

Nitric peroxide,  $\text{N}_2\text{O}_4$ , was considered, from our knowledge of other volatile compounds of nitrogen, to be anomalous in its vapour-volume, being  $\text{N}_2\text{O}_4 = 4$  vols.; and we have been shown by the experiment of Messrs. Playfair and Wanklyn, that the anomaly almost disappears when the compound is evaporated by the aid of a permanent gas at a temperature considerably below its boiling point, as its theoretical molecule  $\text{N}_2\text{O}_4$  is then found to occupy the two volumes which every undecomposed molecule occupies. This explanation seems to me to be the more entitled to grave consideration on the part of the discoverers of the new aluminium compounds, from the fact that the evidence in favour of it has been admitted to be conclusive by Dr. Odling, who classes nitric peroxide by the formula  $\text{N}_2\text{O}_4 = 2$  vols. among compounds with normal vapour-densities, in virtue of the fact that at low temperatures it can be obtained with that density, though having half that density at higher temperatures.



The arguments for admitting that the low vapour-densities of the aluminium compounds are anomalous are even stronger than those which are admitted in the case of nitric peroxide; for it did require very severe superheating to get the aluminium compounds to near four volumes, whereas it required very ingenious devices to get nitric peroxide out of the four-volume state.

Such guiding principles as we have acquired in chemistry are the noblest fruits of the accumulated labours of numberless patient experimentalists and thinkers; and when any new or old fact appears to be at variance with those principles, we either add to our knowledge by discovering new facts which remove the apparent inconsistency, or we put the case by for a while and frankly say that we do not understand it.

The decision of the atomic weight of aluminium has involved greater difficulty than was encountered in the case of most other metals, owing to the fact of our knowing only one oxide of the metal, and salts corresponding to it; but the analogies which connect aluminium with other metals are so close and so numerous, that there are probably few metals of which the position in our classification is more satisfactorily settled. We may safely trust that the able investigators who are examining these interesting compounds will bring them more fully than now within the laws which regulate the combining proportions of their constituent elements; for, as it now stands, the anomaly is far less than many others which have been satisfactorily explained by further investigations.

Meanwhile aluminium is a metal singular for only appearing in that pseudo-triatomic character in which iron and chromium appear in their sesquisalts.

## TECHNICAL CHEMISTRY.

### *Analysis of the Seed of Phormium Tenax,* by Dr. A. ADRIANI.

THE other day a seafaring man, master of an East India-man, gave me as a curiosity a small quantity of the seed and a few unopened—*ergo*, pods containing seed—of the plant well known in Europe as *Phormium tenax*, belonging to the natural family of the Liliaceæ, and yielding the so-called New Zealand flax. As my informant stated that this seed was, or had been, brought to Europe in small quantity to be tried as oil-yielding material, I felt induced to make an analysis of the seed and the pods, since by a first inspection I hardly believed the seed contained any oil at all. The seed is very light; as given me it was very dry, jet black, and exhibiting a lustre as if it were the broken pieces of the wing covers of some insects. The analysis of the seed gave the following results in 100 parts:—

#### Crushed Seed.

Water driven off at 212° . . . . .	8.01
Oil extracted by ether . . . . .	20.08
Resinous matter soluble in alcohol . . . . .	3.80
Gum, mucilage, inuline-like starch, and a trace of legumin, soluble in boiling water	14.32
Albuminous compounds . . . . .	18.28
Woody fibre . . . . .	30.96
Ash . . . . .	4.55
	100.00

The presence of a trace of an albuminous compound in the aqueous solution was detected by adding a drop of acetic acid and afterwards of a solution of ferrocyanide of potassium to the clear aqueous solution, a very

light, flocculent precipitate making its appearance. There is no starch present in this seed of the kind which yields with iodine a blue colouration. The ash, the aqueous solution of which exhibited distinctly an alkaline reaction to red litmus paper, contains phosphoric, sulphuric, and silicic acids; further, chlorine, potassa, soda, lime, magnesia, and oxide of iron. The analysis of the pods freed from seed gave the following result:—

Water driven off at 212° . . . . .	10.70
Waxy fat and a trace of tannic acid, soluble in ether . . . . .	1.00
Resinous and colouring matter soluble in boiling alcohol . . . . .	2.55
Gum, mucilage, sugar, and colouring matter soluble in boiling water . . . . .	24.00
Albuminous compounds . . . . .	6.92
Woody fibre . . . . .	47.93
Ash . . . . .	6.90
	100.00

The ash of the pods was, after having been treated with water, found to have a distinct alkaline reaction. The component elements were found to be the same as those already mentioned for the seed, but in the pods the quantity of phosphoric acid appears to be less. The testing was, however, simply qualitative. In Europe, at least in our latitude, the *Phormium tenax*, though, and this even rarely, yielding blossom, as far as I have been able to ascertain, does not yield fruit. The oil I obtained from a larger quantity of the seed by exhausting it by means of bisulphide of carbon was rather deep yellow coloured, but this is no doubt due to the fact that bisulphide of carbon, though an excellent solvent for oils, also extracts some resinous and colouring matter I think, and as oil-yielding material and as food for cattle the seed and pods of *Phormium tenax* deserve the attention of the inhabitants of New Zealand. The crushed seed has a pleasant smell, and in contact with warm water distinctly reminds me of the fragrance of the *Radix iridis florentinæ* (orris root). The weight of the seed per bushel is 14.952 avoirdupois pounds, this weight being deducted from the actual weighing of one half imperial pint full of seeds. As not many analyses exist of seeds belonging to this class, I thought the communication in your paper might be of interest to some of your readers. I am not aware whether the natives or Europeans settlers in New Zealand make any use of the seed and the pods of the *Phormium tenax*.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, March 2.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., President,  
in the Chair.

THE minutes of the last ordinary meeting were read and confirmed, and the donations to the Society's library duly acknowledged. Mr. Arthur Vacher was formally admitted a Fellow of the Society, and the names of the following candidates were proposed for the first time:—viz., Capel H. Berger, Esq., Lower Clapton; Alexander W. Gillman, Esq., Southfield, Wandsworth; Arthur S. Hobson, Esq., Turnham Green; George B. Robertson, Esq., Stamp Office, Somerset House, and Upper Holloway; Robert Barton, Esq., Bushy Park, Teddington; William Chrispin, Esq., Darlington, Durham; William Judd, Esq., Christchurch, Hants; and Michael Foster, jun., M.D., Huntingdon.



Dr. F. CRACE CALVERT favoured the Society with an interesting communication entitled "*On the Action of Silicate and Carbonate of Soda upon Cotton Fibre.*" These observations arose out of an inquiry into the cause of rottenness which made itself apparent in some white and blue-dyed goods which were shipped to South Africa about two years ago, and were returned to Manchester in consequence of the damage they had sustained. The question was referred to Dr. Calvert to determine, if possible, whether the shippers or the manufacturers were at fault, and the evidence fixed the responsibility upon the latter. Upon opening the bales, the pieces which first came to hand were found to be discoloured, but otherwise retained their original strength and soundness; below these few pieces, and all in the interior of the bales within an inch of the wrappers, were found to be perfectly rotten. Some of the pieces (exhibited) happened to be packed in such a position that their folded edges were in contact with the wrappers, and these parts only remained sound. It was noticed that the oiled cloth or waterproof calico used for packing had become resined by oxidation (according to the principle which, in connection with india-rubber and gutta-percha, had been described by Mr. Spiller at the last meeting), and as a consequence of this change in the nature of the oily material, the bales were no longer protected from the action of water, which entered and left its mark upon the paper lining and flax wrappers immediately inside the oil-cloth packing. In seeking for the cause of deterioration, the author soon ascertained that the goods had not been finished by the old starch dressing, but had been treated according to a more modern process with a solution of silicate of soda. Dr. Calvert then found an indication of liberated alkali in the paper and wrappers, which seemed to point, on the other hand, to the fixation of silica by the fabric. The amounts of silica and alkali were then determined in the white and blue parts of several pieces, and it was found that the material had originally been prepared with silicate of soda to the amount of about 8 per cent. upon the weight of the cotton fibre, and that the portions remaining in a sound condition left on burning but little more than a-half per cent. of ash. The removal of the silicate was thus proved to have had a beneficial effect upon the endurance of the fabric. Proceeding, in the next place, to examine the silicated pieces, it appeared that a considerable proportion of the silica had been rendered insoluble in water; indeed, the larger proportion was fixed by the cotton fibre, having been liberated by the action of carbonic acid upon the silicate, with corresponding formation of carbonated alkali. It had even been suggested by Mr. Walter Crum that not only was the carbonic acid in the air able to decompose the silicate of soda, but that cotton fibre itself might have the power of fixing the silica, and consequently of inducing the liberation of caustic alkali. It was well known that alkalies, both caustic and carbonated, seriously injured the quality of cotton goods, especially if left in contact for a long time; there was, he believed, an oxidising action set up which impaired the strength of the fibre, and besides this he conceived it possible that the mere increase of bulk consequent upon the deposition of silica within the cells had a tendency to cause rottenness. The whites were more injured than the blues, as was to be expected, since the indigo would first take possession of the interstices of the cellular tissue, and oppose the influence of the destructive silicate. The author described the process of treatment to which the cotton goods had been subjected, pointing out the common use of a "resist paste" of sulphate of lead with a little nitrate of copper, to prevent certain portions taking the indigo dye; the pieces were then calendered by passing over heated rollers, and in this operation should any free acid have been present in the copper salt a "softening" of the goods inevitably followed. With the intention of counteracting the effect of this acid,

Dr. Calvert thought it probable that an alkaline bath of silicate of soda had been resorted to, without the knowledge that a similar evil from an opposite course would result. In this inquiry the speaker had derived assistance from Mr. Caro and Mr. Dancer, jun. The first-named gentleman proposed an explanation somewhat different from that which he had himself brought forward. Mr. Caro thought it more probable that the rottenness was ascribable to an increase of bulk consequent upon the action of silicate of soda upon the sulphate of lead in the whites, by which an insoluble silicate of lead, or possibly a double silicate, was formed, and that the expansion of the cotton-cells to an unnatural degree rent the fibre and impaired its strength.

The PRESIDENT moved a vote of thanks to Dr. Calvert for his communication, and for the opportunity of inspecting a series of instructive examples. For his own part, he considered the view entertained by the author—viz., that the presence of alkalies favoured the oxidation of organic substances—to be a rational explanation of the phenomenon.

Professor ABEL said that some experiments he made a few years ago upon the preservation of canvas led him to a conclusion somewhat at variance with that propounded by Dr. Crace Calvert, and adopted by the President. He did not consider the rottenness of the goods to be the result of oxidation, but he would rather attribute it to a mechanical action upon the fibre exerted by the expansive force of crystallisation. The experiments to which he referred were made under conditions very similar to those described by Dr. Calvert: the canvas, or tent-duck, was first impregnated with a solution of basic acetate of lead, and subsequently immersed in aqueous silicate of soda, which had the effect of precipitating a dense silicate of lead within the fibre. The canvas thus prepared was found to be very considerably protected both against fire and the attack of mildew; but there was a diminution in the strength of the material, and the process had to be abandoned. As a confirmation of the correctness of his opinion, Mr. Abel mentioned the result of other experiments, in which flax and cotton fabrics were impregnated with sulphate of magnesia—a neutral salt, which could not be supposed to exert or promote a chemical action upon the fibre, yet the material became weakened merely in consequence of the deposition of solid matter within the fibre, and the unnatural distension of the latter by the act of crystallisation.

Dr. FRANKLAND, having seen Mr. Abel's results and repeated some of the experiments, coincided in the opinion he had just now expressed. He thought there was a parallel between these recent observations and the old familiar fact that the strength of calico and linen cloths became decidedly impaired by frost acting upon them whilst moist. In the examples brought forward by Dr. Calvert he could easily imagine that the dyed portions, being already filled with indigo, would be less assailable than the white parts of the fabric.

Mr. J. T. WAX said that the paper-makers had attempted to use silicate of soda as a mineral sizing upon Spanish grass; but the application did not prove successful. He was reminded of the principle of splitting the fibres of linen by Claussen's process, which failed from the circumstance of the material being injured both by the treatment with carbonated alkali and by the disintegrating action of the carbonic acid gas upon the walls of the cells. The chemical action of silicate of soda could not be much inferior to that of the caustic alkali itself, since the acid in combination was weaker even than carbonic acid. He should not have expected that carbonic acid would penetrate far into the bales, so tightly were the goods packed and so perfectly would the gas be absorbed by the outer layers.

Dr. CALVERT explained how the goods were found to be deteriorated alike at one inch and at eighteen inches'



distance inside the bales, and that even the pieces from the centre gave evidence of the silica having been partially separated and rendered insoluble in the fabric.

Dr. F. CRACE CALVERT then read a paper "*On the Crystallised Hydrate of Phenic Alcohol.*" The author exhibited some beautiful specimens of the new body (which closely resembled glacial acetic acid in colour and general appearance), and stated that it had been obtained by mixing together four parts of carbolic acid with one of water, and exposing to a temperature of about 4° C. with constant agitation. The sides of the vessel became coated with fine large crystals, which took the form of six-sided rhombic prisms. These crystals had a fusing point of 160° C., and they were soluble in water, alcohol, and ether. Their composition was expressed by the formula  $C_{12}H_5O_2 \cdot 2HO$ , which shows it to contain one atom of water, in addition to the elements composing the ordinary monohydrated oxide of phenyl (carbolic acid). On applying heat to the crystals water distils over, and the temperature gradually rises to 187° C.—the boiling point of phenic alcohol. The author made passing allusion to the hydrate of propyl alcohol discovered by Erlenmeyer, and stated that his new substance was the first example known of an alcohol uniting with one equivalent of water to form a crystallised hydrate. Like the so-called carbolic or phenic acid, the solution of the crystals was destitute of acid properties, and did not, therefore, redden litmus paper; he preferred calling the first-named substance an alcohol, and conceived that it bore some analogy to glycerine. The author next described some remarkable results which he obtained by treating the ordinary phenic alcohol with solutions of caustic potassa, of gravities varying between 1.02 and 1.06, which tend to prove that the combination with alkali is not one of a definite character. By way of example, Dr. Calvert stated that if 100 c.c. of potassa solution, sp. gr. 1.03, be used as a solvent, and carbolic acid be added from a burette by measures of 25 c.c. at a time, it would be found that the first and the second portions enter into solution, but that on adding a third measure not only will it remain undissolved, but will determine the separation of a quantity of carbolic acid equal to itself, so that only 25, and not 50, are held in solution by the alkali. Again, carbolic acid may be distilled from a concentrated alkaline ley almost without loss. It absorbs ammonia gas with avidity, but gives it out again on heating; if, however, the ammoniated carbolic acid be heated in sealed tubes, it was known that it could be transformed into aniline and water. Under no circumstances was it possible to decompose an alkaline carbonate by carbolic acid. Both the monohydrate and bihydrate of oxide of phenyl dissolve oxide of lead, forming with it a solid white compound of definite formula



The PRESIDENT remarked upon the beauty of the specimens exhibited by Dr. Calvert, and said he should like to know, if it were possible to communicate the facts, how it happened that the commercial samples of carbolic acid manufactured under Dr. Calvert's direction at Manchester were permanently colourless, whereas the ordinary product invariably turned brown on keeping. He considered the weight of evidence in favour of regarding the substance in question as an alcohol, but it could not be doubted that it presented more marked acid properties than the alcohols of the ethyl series.

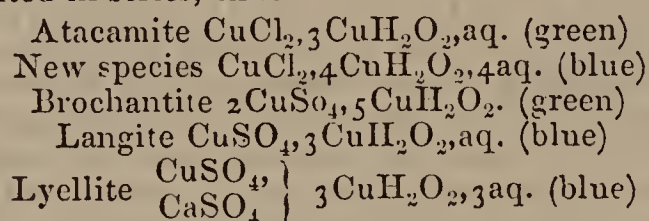
Dr. CALVERT said in reply that considerations of trade interest compelled him to withhold the little piece of information which appeared to be of so much interest to the President. It was to him a fact of considerable scientific importance to know that carbolic acid could be turned out by the ton in a state so pure that the fusing point never varied one degree from the 34° C. which belonged to this body.

Professor A. H. CHURCH, M.A., gave an account of "*Some Hydrated Cupric Oxychlorides from Cornwall.*" The

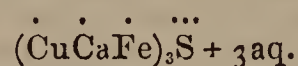
author described particularly a new species of atacamite which he had lately received from Mr. Talling, of Lostwithiel. The colour of the mineral is turquoise-blue, it occurs in thin crusts, presenting a botryoidal appearance under the microscope. Its hardness is equal to 3, and density about 3.5. It is not attacked by water, but is readily soluble in dilute acids, and the solution gives the reactions of chlorine and copper. Besides these elements the mineral contains water. In the matrix were calcic sulphate, and ferric oxide, which had to be carefully separated from the sample analysed. The formula deduced from its quantitative examination was—



Besides differing in colour from the ordinary variety of atacamite, it contains more water, and more cupric oxide united to the chloride, a difference which has a parallel in the blue modification of brochantite, which, under the name of langite has been lately described by Professor Maskelyne. The formulæ of these several minerals were represented in series, thus—



The author stated that the sample of green atacamite analysed by him in order to furnish a comparison with the blue variety was found at St. Just, in Cornwall, and in a copper mine situate close to the sea; the amount of water is smaller than in other known varieties of the mineral. Its origin was attributable to the action of salt water upon copper lodes, and the chlorides both of sodium and magnesium were detected in the specimen. With regard to the new Cornish mineral, Mr. Church stated that a similar compound had been produced artificially by Sir Robert Kane: it contained, however, but two instead of four atoms of water. The author made some statements with regard to "*The Hydrated Cupric Oxy-sulphates from Cornwall,*" and challenged the accuracy of an analysis lately made by M. Pisani, who appears to have re-named the mineral discovered by Prof. Maskelyne, calling it now "*Devilline,*" and attributing to it the mineralogical formula—



The chief point at issue seems to be the question whether iron is a legitimate constituent of the mineral. Prof. Church believes that it occurs only as an impurity in the form of ferric oxide mechanically intermixed. The result of his analysis of the mineral "*Lyellite*" is stated above.

Mr. F. FIELD had frequently examined samples of the green atacamite, both of natural and artificial formation, but always found that they contained four equivalents of water. The occurrence of a blue variety of oxychloride of copper was an interesting fact.

Mr. NEWLANDS objected to certain forms of expression made use of by Prof. Church in the latter part of his communication. It was stated that "if cupric chloride existed as such in the mineral, boiling water should remove it; the cupric hydrate would also be blackened by conversion into oxide." The speaker believed it was generally admitted that double salts were capable of exhibiting new properties. If this were not true, he might argue that the platino-potassic chloride does not contain chloride of platinum because it cannot be dissolved out by water. Besides, as to the fact, if the minerals were formed by the action of sea-water any soluble cupric chloride must be removed in the process of formation.

The PRESIDENT did not acquiesce in the use of the term "*sulphuric anhydride*" when the author said that "*Lyellite* contains copper, calcium, sulphuric anhydride, and the elements of water."



Professor CHURCH defended himself by saying that it was difficult in the present day to avoid the charge of misrepresentation, for the same body was called by so many different names; that he had, in his paper, described the drying of his samples over "oil of vitriol," using the original name in preference to sulphuric acid, hydric sulphate, and other terms of later adoption. In employing the term "sulphuric anhydride," he meant to convey the information that the mineral contained the body which gives barium sulphate with chloride of barium; and at that stage of the qualitative examination he could not say how it was combined, for these particulars had to be considered later in the discussion.

The SECRETARY read the programme relating to the election of officers for a second time. In addition to the names already published was that of Dr. Frankland, as foreign secretary. The meeting was then adjourned until Thursday, March 16.

### PHARMACEUTICAL MEETING.

Wednesday, March 1.

Mr. HILLS, Vice-President, in the Chair.

THE first paper read was "*On Phosphate of Ammonia of the British Pharmacopœia*," by Mr. John Watts, Senior Bell Scholar. He considers the field of criticism of the British Pharmacopœia nearly exhausted, but in the prospect of a new edition every contribution towards an exact knowledge of the materia medica becomes of interest. With this idea he undertook the examination of the phosphate of ammonia which is produced when the directions of the Pharmacopœia are strictly followed. The formula,  $3\text{NH}_4\text{O},\text{PO}_5 + 5\text{HO}$ , is ascribed to the compound, but the accuracy of the formula has been questioned. Generally speaking, when phosphoric acid is neutralised with an alkali, we do not obtain a salt with three atoms of base, but a compound of two atoms of base, one of water, and one of acid. The former result would appear to be much more doubtful in the case of an ammonia salt, since it is stated that the triammonic salt, if formed, cannot be dried, and retain its composition. The author found this assertion to be, to a certain extent, correct: when dried with all precaution, some ammonia was given off. In his analysis of the salt, therefore, the ammonia was always too low, and the phosphoric acid consequently too high. The general results, however, showed that for once the formula of the British Pharmacopœia was correct. Details of the analyses were then given, from which we quote only the percentage results:—

	I.	II.	III.	Calculation.
$\text{PO}_5$	38.06	38.02	37.89	$\text{PO}_5$ . 36.59
$\text{NH}_4\text{O}$	39.05	38.2	—	$3\text{NH}_4\text{O}$ . 40.20
				$5\text{HO}$ . 23.21
				100.00

The phosphoric acid was estimated by means of nitrate of uranium, and also as pyrophosphate of magnesia; the ammonia was determined by Peligot's method. Allowing for unavoidable loss of ammonia, the above results agree sufficiently near with the Pharmacopœia formula, and there can be no doubt that the phosphate prepared according to it is a triammonic salt. No analysis of such a salt has, however, been published before. The author then pointed out that in the analysis of these phosphates it was impossible to say, from a determination of the ammonia alone, whether the compound was a di- or tri-ammonic salt, the proportion of ammonia in these two salts being the same—one containing five atoms of water, and the other none. Mr. Watts also analysed several specimens of commercial phosphate of ammonia. The mean of the results gave 53.29 per cent. of phosphoric acid, which closely agrees with the composition of the diammonic salt, requiring 53.79 of acid. As the samples were not purchased

until after the publication of the British Pharmacopœia, the author considers that the salts were not made according to its directions, or came from an old stock, for, unless very carelessly kept, the tri- salt does not so completely change to the diammonic salt. The next questions discussed were, which of these two salts is the best for medicinal use, and which is most easily and cheaply prepared. In making the triammonic salt there is a great loss of ammonia, the product is always unstable, and there can be no use in having the three atoms of ammonia if they will not remain in the salt. On the large scale the manufacture of the triammonic salt is impracticable. In use it becomes converted into the diammonic salt. The author found that when fully exposed to air for two hours, the Pharmacopœia salt lost one atom of ammonia. A salt with two atoms of ammonia is, on the contrary, very stable, and can be easily prepared by a process similar to that employed for phosphate of soda. The solution kept faintly alkaline yields crystals of the exact composition which are permanent. If the solution be acid, the result is a mixture of the mon- and di-ammonic salt. The latter, then, undoubtedly appears the best from a pharmaceutical point of view. Mr. Watts related that he had only once seen phosphate of ammonia in a prescription, and then it was ordered by a member of the Pharmacopœia Committee in combination with bicarbonate of potash and citrate of lithia. The mixture of these salts was directed to be well dried, and since it was impossible for the triammonic salt to exist in such a condition, it may be inferred that physicians set but little value on the third atom of ammonia. Mr. Watts next referred to the arseniates as closely connected with the phosphates; all said about the latter will apply to the former salts. Triammonic arseniate agrees in every respect with the corresponding phosphate. Arseniates of commerce proved on examination to be mixtures of the mon- and di-ammonic salts. Their solution was faintly acid, which led to the conjecture that they had been crystallised from solutions, not preserved alkaline.

Dr. ATTFIELD remarked that phosphate of ammonia was said to be administered in gout and rheumatism to render the urates of soda and lime in the blood soluble; he wished to ask Mr. Watts whether he had made any experiments to determine the solubility of these salts in solutions of the phosphate of ammonia?

Mr. WATTS replied that at present he had made no determinations.

The next paper was "*On a Better Mode of Preparing Red Oxide of Mercury Ointment*," by BALMANNO SQUIRE, M.B. Dr. Squire recommends the use of the precipitated binoxide of mercury for ointments in place of the nitric oxide, as it is called. The former, being in a much finer state of division, is more active, and a smaller quantity suffices. The smoothness of the ointment, besides, recommends it for application to delicate tissues as preferable to the gritty preparation which is got even with the best levigated nitric oxide. Comparative trials made with ointments prepared with the two oxides seemed to show the superiority of the precipitated yellow oxide, which the author hoped would come into general use.

Mr. SHILLCOCK exhibited a "Poison Bottle" of his invention. The peculiarity was a simple contrivance for securing the stopper by means of a screw. A short discussion on poison bottles in general followed, in the course of which Mr. Morson sagaciously remarked that the best of them was but a clumsy substitute for the care and intelligence which should always be exercised when dealing with such important matters as remedies and poisons.

The meeting then adjourned until April 5.

### ACADEMY OF SCIENCES.

February 27, 1865.

M. PELOUZE described "*A New Compound of Water and Carbonate of Lime*." The author has for some years



studied the chemical reactions which take place at low temperatures, and has before shown that in some the changes which take place are different from those which happen at ordinary temperatures. Thus, at  $-15^{\circ}$  binoxide of nitrogen combines with an alkaline sulphite to form a nitro-sulphite, while at  $0^{\circ}$  the same gas is completely destroyed, and, instead of a new salt, only a neutral sulphate and protoxide of nitrogen are obtained. He has now passed carbonic acid into lime-water cooled to  $0^{\circ}$  or  $+1^{\circ}$  or  $2^{\circ}$ , and found that a flocculent precipitate is at first formed, which soon changes to a heavy crystalline powder, and which, after washing with iced water and dried at a low temperature between folds of blotting-paper, is found to contain 52 per cent. of water. This corresponds to six equivalents of water to one equivalent of carbonate of lime; the formula of the salt, therefore, will be  $\text{CaO}, \text{CO}_2 + 6\text{HO}$ . A slight elevation of temperature soon decomposes this compound. At  $30^{\circ}$  it becomes a pasty mass, which is only a mixture of carbonate of lime and water, like ordinary chalk and water. The same compound is formed when solution of chloride of calcium and carbonate of soda cooled to  $0^{\circ}$  are brought together. A carbonate of lime with five equivalents of water is slowly formed when a solution of lime in weak syrup is exposed to the air, as Daniel and Becquerel have shown. Carbonic acid passed into a similar solution cooled to  $1^{\circ}$  or  $2^{\circ}$  gives rise to a salt with 6 HO. Between  $10^{\circ}$  and  $20^{\circ}$  the precipitates formed have only 27 per cent. of water. At  $30^{\circ}$  carbonate of lime is always anhydrous. Soluble salts are known to crystallise with various proportions of water, according to the temperature; but insoluble salts, like carbonate of lime, generally refuse to combine with water.

M. Persoz read a memoir "*On the Transformation of Protoxide of Nitrogen into Nitric Acid and Ammonia.*" Nitrous oxide, procured in the ordinary way from fused nitrate of ammonia, the author first passes into a cooled tubulated receiver to arrest most of the water, and then through a curved tube, the bend of which is filled with hydrate of potash mixed with lumps of lime, so as to allow gas to pass freely. The curve is heated to dull redness, and as soon as the current of moist protoxide is well established, an abundant disengagement of ammonia is recognisable, and after continuing the experiment for some time, nitric acid may be found in the saline mass in the tube. The author considers the molecule of nitrous oxide as more complex than is generally supposed, and thinks it contains besides the latent heat which keeps it gaseous, some accumulated heat which gives to it some of the properties of peroxide of hydrogen and other peroxides and acids, bodies which in their molecular changes disengage more heat than theory can account for. The doubled molecule,  $\text{N}_2\text{O}_2$ , he thinks comparable to some of the foregoing compounds. And now, as it then represents all the elements of nitrate of ammonia less four equivalents of water, we ought, by making it react on water, to regenerate the nitric acid and ammonia, which the author has done.

M. Deherain read a note "*On the Use of Gypsum on Arable Lands.*" The author says that gypsum changes carbonates of potash and ammonia, which argillaceous soil obstinately retain, into sulphates, which are not so easily retained, and hence he concludes that gypsum facilitates the passage of alkalies into the lower layers of soil, and so favours the vegetation of plants whose roots go deep (leguminous), while it has no effect on cereals, the roots of which do not go beyond the upper layer. The author explains the absence of sulphuric acid in the ashes of plants on the supposition that sulphates are reduced in the deep layers of soils.

M. Bechamp presented a note "*On an Albumenoid Ferment in the Urine.*" Nefrozymase is the name that the author has given to the new substance he has discovered in that much-studied, but apparently little-understood, fluid, human urine. To obtain the substance filter the urine of a healthy individual, and then carefully add

twice or three times the volume of strong alcohol. A flocculent precipitate slowly collects, which must be washed with weaker alcohol (75 per cent.). The precipitate is a mixture of the albumenoid matter and earthy phosphates. Ordinarily, 1000 c.c. of urine contain from 0.3 to 0.65 grm. of the matter, but the quantity seems to vary, according to age, sex, diet, and time of day. Water will dissolve the matter, which gives all the chemical reactions of albumenoid matter, and possesses besides the properties of an active ferment. It quickly liquefies starch paste, and soon changes it into glucose; but it is less active in this respect than saliva and diastase. The author expects to show that the ferment is formed in the kidneys at the expense of the albumenoid matter in the blood, and he thinks the body of great pathological importance. The urine of dogs and rabbits also furnishes nefrozymase.

M. Reveil read a long memoir "*On the Application of Dialysis to Toxicological Researches, and the Use of the Iodide of Mercury and Potassium as a Test for Alkaloids.*" We see nothing new in the author's summary, except the statement that the separation of crystalloid from colloid bodies is much more rapid when there is a great difference of temperature between the liquid in the dialyser and the diffusate—a condition of things which it is admitted is difficult to maintain.

A note "*On the Sucrates of Lead,*" by MM. Boivin and Loiseau, tells us that the authors believe in a radical  $\text{C}_{12}\text{H}_8\text{O}_8$  sucric acid—a tribasic acid, which, with three of water, forms crystallised sugar  $\text{C}_{12}\text{H}_8\text{O}_8\text{H}_3\text{O}$ , or a tribasic sucrate of water, the type of all sucates. The so-called bibasic sucates they consider  $\text{C}_{12}\text{H}_8\text{O}_8\text{HO}_2\text{MO}$ , and they remark that these salts are in general found at a low temperature. The sucates of lead seem to possess no particular interest.

MM. P. and E. Depouilly communicated "*A New Method of Making Benzoic Acid.*" They mix an equivalent of neutral phthalate of lime (bicalcic phthalate) with an equivalent of hydrate of lime, and heat it to  $330^{\circ}$  or  $350^{\circ}$  for some hours protected from too much air. At the end of this time the salt is completely changed into benzoate and carbonate of lime.

$\text{C}_{16}\text{H}_4\text{CaO}_8 + \text{CaO}, \text{HO} = \text{C}_{14}\text{H}_5\text{CaO}_4 + 2\text{CaOCCO}_2$ .  
The benzoate of lime may be extracted by water, and the benzoic acid precipitated from the concentrated solution. This splitting up of phthalic acid was foreseen by Gerhardt and Berthelot, and was attempted without success by M. Dusart.

A note by M. Vionnois "*On the Reflection of Sound*" explains the cause of rolling thunder. He was at the camp at Nancy, and heard the echo of the firing, not sharp and dry, but somewhat confused and prolonged. He then noticed that he was separated from the field by some trees, and concluded that the leaves of these were the reflecting surfaces. This led him to think that the explosion of the electric spark might be reflected by the vesicular vapour of the clouds, and the noise be softened and prolonged by the inequality of the distances and the successive reflections.

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 21, 1865.

R. ANGUS SMITH, Ph.D., F.R.S., &c., President, in the Chair.

MR. THOMAS WORTHINGTON was elected an ordinary member of the Society.

M. BREGUET, of Paris, exhibited and explained the construction of Dumas' lamp for use in coal mines, the principle of which consists in the employment of the light from a Geissler's vacuum tube, excited by a small Ruhmkorff's induction coil.

Professor Roscoe stated that he had very frequently been asked for information respecting the mode of pre-



paring the sealed bulbs, containing exactly equal volumes of chlorine and hydrogen gases, which he employed for exhibiting the chemical combination of these gases effected by the action of light, and as the successful preparation of these bulbs depends upon exactly observing certain minute conditions, he ventured to submit the following particulars to the Society. The apparatus needed consists of a stout tube or narrow bottle of about 120 cubic centimetres capacity, fitted with a caoutchouc stopper with three holes bored through it. Into one of these holes a vent gas delivery tube passes, on to which three small wash bulbs are blown; into the other two holes are inserted the rounded ends of two lengths of the gas carbon, commonly used as terminals for the electric lamp; these poles are of such a length that they pass to the bottom of the glass bottle. This is then filled with strong aqueous hydrochloric acid containing about 30 per cent. of the anhydrous acids; the stopper in the poles and wash bulbs containing a few drops of water is then fixed into its position, and the evolution vessel placed in a beaker of cold water, whilst contact is made with the terminals of four ordinary sized Bunsen's cells, the whole apparatus being placed in a dark room. The mixed gases at once begin to be given off, and ought to pass through the wash bulbs at the rate of about two bubbles per second. It is absolutely necessary that the gas be allowed to come off at this rate for three hours\* before it is collected, as up to this time it does not attain a sufficient degree of purity and sensitiveness, whilst after the lapse of this time it is generally found to be fit for use. In order to absorb the excess of chlorine, the waste gas may be led into a condenser containing slacked lime and charcoal in alternate layers. When the evolution has gone on for the above-mentioned time a bulb tube, connected by caoutchouc joinings, is placed between the evolution vessel and the condenser, and the gas allowed to pass through. The bulbs, which are made of fusible glass tubing, are blown about the size of a hen's egg, and so thin that they easily break when pressed with the finger. At each side of the bulb the tube is drawn out so as to be very thin in the glass, and to leave the internal diameter not less than 1mm., whilst at the extremities the tube is wider, so as to fit ordinary joinings. When the gas has passed through the tube for about ten minutes, the joinings are loosened and each end stopped with a piece of glass rod. The bulb tube thus closed is then removed from the evolving vessel, and the thinnest part of the tube brought some little distance above a very small Bunsen's flame; the glass then softens below a red-heat, and the ends may be drawn out and sealed with safety. It is advisable to number the bulbs, and to test the first and last by exposing them to a strong light. Frequently, in spite of every precaution, the gas explodes during the act of sealing, so that in this operation it is advisable to hold the bulb with a cloth rather than in the open hand. As soon as one bulb-tube is removed, another is placed in connection with the evolution flask, and, after ten minutes, sealed as described. The above quantity of acid will serve for the production of sixty bulbs. Thus prepared, the sealed bulbs may be kept in the dark for any length of time without injury; some, which were known to have been made more than a year, were found to be perfectly good. To explode these bulbs it is only necessary to expose them to diffuse daylight or sunlight, when the combination occurs instantly. Of artificial lights, the bright flash produced by the combustion of the vapour of bisulphide of carbon in nitric oxide is most effective; but the light of burning magnesium wire, of phosphorus in oxygen, or the electric light, answers perfectly well. Professor Roscoe stated that Mr. Dancer, of Cross Street, had undertaken to supply the bulbs to persons unable to prepare them.

A paper was also read "*On the Action of Caustic Soda on Ethylic and Methylic Alcohol*," by Mr. A. Mylius, which we shall give in a future number.

\* See Bunsen and Roscoe, "Photochemical Researches," 1857, p. 355.

## NOTICES OF BOOKS.

*The Spirit of Nursing.* By HARRY JONES, M.A. London: Hardwicke. 1865.

It may be asked what chemists have to do with nursing. But all of us have once been infants, and every average life, the statisticians tell us, must expect so many weeks (we forget how many) of sickness; and, moreover, some of us may live to get old. And all we need say respecting this little book is, that for infancy, sickness, or old age, give us such an attendant as is here sketched by Mr. Jones.

*Bulletin de la Société Chimique de Paris.* February, 1865.

WE noticed the proceedings of the Chemical Society of Paris in our last number, but now refer at greater length to some of the communications made to the Society. M. Jodin, in his paper "*On the Changes in Vegetable Tissues under the Influence of Air and Light*," detailed some experiments the results of which he communicated some months ago to the Academy of Sciences, and so noticed at the time in the CHEMICAL NEWS (vol. x., p. 273). Although there was nothing new in the results obtained, some of the experiments are novel. The author destroyed the vitality of green leaves by immersing them in alcohol, or heating them to a high temperature in sealed tubes, and found that after this the leaves still presented some signs of life. In the light they were rapidly decolorised, but excluded from air and light they preserved their greenness for an indefinite time. In the course of the decoloration by solar light, he proved that oxygen was absorbed and carbonic acid evolved. Under the same circumstances he found the yellow matter in etiolated leaves to absorb oxygen. On the contrary, it was proved that etiolated leaves, in becoming green in the light, evolved oxygen, while those kept in the dark and unchanged in colour absorbed oxygen. The author is disposed to regard chlorophyll as a body quite distinct from the yellow colouring matter of leaves.

M. Lieben's paper "*On Anomalous Vapour Densities*" is a reply to M. Deville. It is impossible to condense the reasoning of the author, who contends that the experiments of M. Deville on the vapour density of chloride of ammonium are not in contradiction to the law of Avogadro and Ampère.

In a communication "*On the Constitution of Aromatic Substances*," M. Kekulé developes some views which could not be made intelligible without the diagrams here given. He considers that in all aromatic substances there is a common group, a sort of nucleus, formed of six atoms of carbon. His reasons for thinking so are—1, that even the simplest aromatic substances are relatively richer in carbon than the analogous fatty substances; 2, that homologous substances (that is to say, bodies which differ from each other by  $n\text{CH}_2$ ) exist in aromatic groups; 3, that the simplest bodies belonging to an aromatic group contain at least six atoms of carbon. Further, by the influence of energetic reagents, we always derive, even from relatively complex matters, substances which only contain six atoms of carbon (benzine, phenic alcohol, picric acid, aniline, &c.). M. Kekulé supposes that in the interior of the nucleus the carbon exists in a more condensed state than in the fatty substances. He then proceeds to explain the constitution of the nucleus according to his own view of the tetratomic nature of carbon. He supposes that the six atoms of carbon may unite in such a way that either eight or six affinities remain unsaturated. From the latter combination, which the author designates a *closed chain*, aromatic substances are derived; from the former, called an *open chain*, such derivatives as quinone and chloranide are formed. These modes of combination are represented pictorially in diagrams, some of which we may reproduce hereafter.



In the analysis of foreign memoirs which follows the proceedings of the Society we find few papers of interest which we have not noticed.

A note by Beilstein "*On the Reducing Action of Tin and Hydrochloric Acid on Nitrated Bodies*" shows that in this action the whole of the  $\text{NO}_2$  in a body is replaced by  $\text{NH}_2$ , which does not happen when sulphuretted hydrogen is employed. Tin and hydrochloric acid may, therefore, be used to reduce all nitrated bodies, while iron filings and acetic acid are only convenient when the product found is a volatile base.

M. E. Kopp continues his paper "*On Artificial Colouring Matters*," in which we find little which has not appeared in our pages. In this chapter he quotes from M. Krouber, to the effect that the light oils, the boiling points of which lie between  $90^\circ$  and  $110^\circ$ , yield the best aniline for the manufacture of colours. Such oils will, in fact, consist almost entirely of benzole and toluol.

*Annalen der Chemie und Pharmacie.* February, 1865.

WE find nothing of general interest in this number which we have not before noticed, except a curious paper by Schwarzenbach "*On the Relation of Albumen to Caseine*." The author has examined platinocyanides of these bodies; and from their analysis he concludes that the combining proportion of caseine is exactly the half of that of albumen (albumen = 1612; caseine = 806)—in other words, caseine is albumen split asunder.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

222. J. H. Pepper, Boundary Road, St. John's Wood, and T. T. Tobin, North Street, Pentonville, "A new or improved apparatus for illusory exhibitions."—Petition recorded January 26, 1865.

320. W. E. Newton, Chancery Lane, "Improvements in the preparation of superphosphate of lime."—A communication from R. B. Potts, Camden, New Jersey, U.S.A. February 4, 1865.

414. W. C. Hine, Swineshead, Lincoln, "Improvements in stoppering bottles or other similar vessels, and measuring quantities therefrom."—February 14, 1865.

437. R. H. Emerson, Dublin, "A new or improved invalid or syphon drinking cup."—February 15, 1865.

447. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling petroleum and other volatile liquids and for making gas."—A communication from G. H. S. Duffus, New York, U.S.A.

448. J. F. Hearsey, Park Place, Brompton, "Improved apparatus for measuring the specific gravity of liquids."—A communication from E. Payne, Montreal, Canada.

449. F. A. Laurent, J. Carthelaz, and N. Basset, Rue St. Croix de la Bretonnerie, Paris, "Improvements in the manufacture of oxalic acid."

451. R. Smith, Cumming Street, Pentonville, Middlesex, "Improvements in treating sewage, and in arranging apparatus in sewers and culverts to facilitate the ventilation of such structures."—Feb. 16, 1865.

456. J. O. Christian, F.C.S., Manchester, J. Charlton and H. Charlton, of Strangeways, Lancashire, "Certain improvements in the manufacture of magnesium and its compounds."

460. C. F. Claus, Fernhead, Lancashire, "Improvements in obtaining sulphates and carbonates of potash and soda."—Feb. 17, 1865.

465. C. Brakell, W. Hoehl, and W. Günther, Oldham, Lancashire, "An improved composition as a substitute for leather or other similar materials."

467. R. A. Brooman, Fleet Street, London, "Improvements in filters."—A communication from G. Planche, Paris.—Feb. 18, 1865.

486. W. E. Newton, Chancery Lane, "Improvements in apparatus for extracting liquid from solid substances."—A communication from L. Smith, Erie, Penn., U.S.A.—Feb. 21, 1865.

### NOTICES TO PROCEED.

2581. W. Taylor, Shiffnal, H. Harrison, and G. Harrison, Hollingswood, Shropshire, "Certain improvements in the manufacture of iron."—Petition recorded Oct. 19, 1864.

2605. L. Paviola, La Crotat, France, "An improved anti-saline coating, chiefly applicable for preserving from corrosion and incrustation the boilers and pipes of marine steam engines."—Oct. 21, 1864.

2645. J. Dannatt, Sunderland, Durham, "An improved composition for preventing the fouling of the bottoms of ships and vessels, and for the preservation of the iron or wood of which the same are constructed."

2646. P. Dutrulle, Davies Street, Grosvenor Street, Grosvenor Square, "Improvements in the manufacture of syrups." A communication from J. J. Grosheing and A. Sheurer, Logelbach, Haut Rhin.—Oct. 26, 1864.

2666. D. Laidlaw and J. Robertson, Glasgow, N.B., "Improvements in exhausting, forcing, compressing, heating, cooling, and applying aëriform bodies, and in apparatus therefor."

2673. W. Cormack, Little Moorfields, "Improvements in the distillation or destructive distillation of solid matters or semi-solid matters capable of yielding fluids or gaseous hydrocarbons, or other products, such as pit coal, bog-head, or other bituminous coal or shale, peat, wood, asphalts, tallow, lard, fats, or other solid or semi-solid matters, and in the machinery or apparatus employed therefor."—Oct. 28, 1864.

2800. W. Willis, Birmingham, "Improvements in processes for copying or reproducing by the agency of light drawings, engravings, lithographs, and photographs, and written and printed documents."—Nov. 11, 1864.

2844. M. Henry, Fleet Street, London, "Improvements in the mode of, and apparatus for, carbonising wood and performing other operations in which substances are treated by flame or heat."—A communication from P. Hugon, Boulevard St. Martin, Paris.

2889. S. Piesse, New Bond Street, Ph.D., "Improvements in apparatus for creating and projecting cold vapours."—Nov. 18, 1864.

176. B. F. Stevens, Henrietta Street, Covent Garden, "Improvements in vulcanising compounds and vulcanised fabrics."—A communication from S. Stevens, New York, U.S.A.—Jan. 20, 1865.

330. A. A. Hulot, Imperial Mint, Paris, "A new typographic ink."—Feb. 6, 1865.

418. A. Fryer, Manchester, "Improvements in the mode of treating for evaporating and concentrating purposes cane juice and saccharine and other solutions and liquids, and also in machinery or apparatus for the concentration of cane juice and saccharine and other solutions and for the evaporation of liquids."—Feb. 14, 1865.

## CORRESPONDENCE.

### Continental Science.

PARIS, March 7.

THE Chemical Society of Paris seem to be in a flourishing state financially as well as scientifically. The treasurer's account for the past year shows a considerable balance in hand, although under the head expenditure I notice an investment made this year in the shape of seven railway shares. This in England would seem an odd way of investing money for a learned society; but, as all French railways



will in time become the property of the State, I suppose it may be considered in the light of an investment in the funds. The Society has now received what is equivalent to a charter of incorporation in England, and can legally accept legacies, so I have no doubt its circumstances will soon still further improve.

I rather think that I have read the following information in the CHEMICAL NEWS already, but as I find it in *Les Mondes* as novel I will send it. Speaking of *Les Mondes*, I may say that the *jours gras* have brought a *jour maigre* for the readers of that journal, the learned editor having fallen back on an old stock, among which I fancy he found the news (?) that the prize which is awarded by the Belgian Government every five years for the work of the greatest merit on the mathematical and physical sciences published in the interval, has been conferred for the last quinquennial period, 1859-63, on M. Stas for his researches on the reciprocal relations of atomic weights. The jury in their report dwell particularly on the really scientific object of the author's researches, and speak of the rare merit of their execution, praise in which all who know the work in question will cordially join.

A curious form of native iron is said to be found in many Swedish lakes. It is dredged up from the bottom of the lakes in the shape of small hollow globules which are sometimes full, and always covered with something which protects the metal from oxidation. The people dredge it up periodically, and find that from time to time new deposits are formed, which are not sufficiently deep to pay for the dredging until twenty-five or twenty-six years have elapsed. The metal has always been supposed to be formed by the reduction of the oxide brought by natural drainage through a highly ferruginous soil, but still it was difficult to explain by what agent the reduction was effected, and to account for the peculiar globular form, and the circumstance that the metal resisted oxidation. Accident, however, has recently enabled Dr. Sjogreen to make the discovery of the true origin of the metal. He has found that the water of the lakes is full of infusoria; and he has watched them all busily occupied in surrounding themselves with an envelope of oxide of iron from which they absorb the oxygen, and become encased in a shell of pure iron during the larva state. The perfect insect escapes from his suit of mail through a hole left for the purpose. How the iron is preserved from oxidation Dr. Sjogreen has not yet been sharp enough to discover, but he will no doubt tell us some day. In the meantime he has certainly written a curious paper on lake ore.

In the dearth of chemical novelties, I may mention that Signor Bianconi contends that the *Epiornis maximus* was a species of vulture closely allied to the condor.

The magnesium light may after all turn out to be of some use. There is no taking decent photographs by means of it, but it certainly does light up dark places well, and M. Maisonneuve has been looking by its help into a patient's larynx, where everything was seen as clear as daylight.

#### *Boussingaultite.*

To the Editor of the CHEMICAL NEWS.

SIR,—In your valuable journal for January 27 is an account of the proceedings of the Chemical Society for January 19, in which Mr. Buckton, in describing the native sulphate of ammonia from Tuscany, mentions that this salt has lately been obtained by passing a mixture of sulphuretted hydrogen, atmospheric air, and steam through a heated earthenware tube. It does not there appear whether this very interesting observation is due to Mr. Buckton or another. Perhaps he will kindly communicate through your pages some further information on the subject, and oblige a fellow-chemist.

I am, &c.

F.R.S.

Montreal, February 16.

#### *On Cotton Seed Oil.*

To the Editor of the CHEMICAL NEWS.

SIR,—In reference to Dr. Adriani's letters on this subject, I may state that I know of three or four large firms at the present time who are, and have been for a considerable time, refining large quantities of cotton seed oil. I know one firm who tried some years ago to obtain a green dye from the refuse in the process without success. Also, I worked for some time on the subject in endeavours to make the green fatty matter suitable as a dye, altogether without success. There are some great reasons why a solution of caustic soda will not answer on the large scale in refining the oil; and I was surprised to see Dr. Adriani says that he could obtain a good result by the use of this reagent.

The green fatty matter is soluble in coal naphtha, which, on evaporation, leaves a residue of a brown colour, and which is soluble in alkalies, and may be reprecipitated in a green mass by acids. By precipitation with copper, or barium, or calcium salts, the fatty matter is thrown down as a salt or insoluble soap of a dirty green colour.

The practical loss in refining is, as far as I can learn, about 10 per cent. Immense quantities of the pure or refined oil are shipped for Italy. Whether we eventually take cotton seed oil in our salad as olive or Gallipoli oil, I leave to you or your readers to say. I am, &c.

JOHN S. BLOCKEY.

Leeds, February 27.

[We have ourselves seen soda used with success in the refining of cotton oil on a large scale, but with a considerably greater loss than our correspondent states. Potash, for some reason or other, answers the purpose of "cutting down" the oil much better. The refined oil is notoriously exported for the adulteration of olive oil.—ED. C. N.]

#### *Metallic Vegetation and Veins.*

To the Editor of the CHEMICAL NEWS.

SIR,—On the subject of the "scientific curiosity" mentioned by your Paris correspondent in his last letter, I would beg to submit to such of your readers as may be interested in the matter an account of an experiment I made about two years ago while investigating the properties of alkaline silicates.

The experiment is very simple, and will have not only a very beautiful effect, but, contrary to that of M. Jules Faure, shaking will not destroy the arborescent-like growth, nor at all affect its beautiful appearance when formed.

Let a solution of chromate of potash be mixed with a clear solution of silicate of soda to such an extent that when gently heated the two solutions may form a gelatinous mass. Let this settle in a clear glass vessel. Then take crystals of sulphate of copper coarsely powdered, cause them to be dropped in small scattered quantities on the surface of the mass. Wherever a particle of the sulphate of copper touches the surface of the gelatinous silicate, a pellicle of chromo-silicate of copper will form. The particle then falling to the bottom, the same compound forms along its course downwards, but at first invisible to the eye; but when each particle arrives at the bottom a fresh growth of the mineral ore begins to ascend along the course by which it has descended, and so on from each individual particle up to the spot where it originally touched the surface; there it joins the pellicle, and the growth ceases.

I think the mineral veins thus formed are tubular. The place where the particle of crystal first touches the gelatinous mass will be greater in diameter than the rest of the tubular structure, and the whole will bear a striking resemblance in form to a growth of cup-moss lichen (*cladonia pyxidata*). The gelatinous mass, when exposed to the air, will become solid, but will retain its original



transparency, and the beautiful mineral arborescence may be preserved in that state for an indefinite period.

By varying the experiment, and using other gelatinous silicates and crystals of other metallic salts, very instructive lessons may be gained, and the experimenter may have formed before his eyes and become the possessor, within a few hours on a fine summer's day, of a number of miniature mines of lead and iron, zinc and copper, and silver and gold, the ores of which he will see branching in veins through the transparent matrix; and the reflection will occur to him that he is witnessing on a small scale a close imitation of some of Nature's own grand formations.

I am, &c.

HENRY ELLIS, M.R.C.S.

Bangor, March 3rd, 1865.

## MISCELLANEOUS.

**Chemical Society.**—The next meeting of this Society will be held on Thursday, March 16, at eight o'clock, when the following papers will be read:—"Action of Chlorine on Arsenious Acid," by Professor Bloxam; "Vapour Densities," by Mr. J. A. Wanklyn.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday, March 14, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Thursday, March 16, at 3 o'clock, Professor Hofmann, F.R.S., "An Introduction to Chemistry." Friday, March 17, at 8 o'clock, Balfour Stewart, Esq., "On the Latest Discoveries Concerning the Sun's Surface." Saturday, March 18, at 3 o'clock, Professor Marshall, F.R.S., "On the Nervous System."

**A Revised Pharmacopœia.**—The Medical Council has appointed Mr. Warrington, F.R.S., and Professor Redwood to revise the British Pharmacopœia, with a view to the publication of a new edition as soon as possible.

**Malt as Food for Cattle.**—A preliminary report by Mr. Lawes establishes that the increase of live weight in animals fed upon malt is less than in those fed on unmalted barley. In the case of cows, too, less milk was given by the malt-fed than by the barley-fed animals. The experiments of Mr. Lawes were very conclusive, and appear to have been very fairly conducted.

**Ozone and Antozone.**—We understand that Schönbein has at last been successful in his long endeavours to isolate the bodies of which he has contended that ordinary oxygen is composed. Antozone, it is said, has a lower specific gravity than hydrogen. It liquefies at a pressure of 150 atmospheres. Ozone is a denser gas. The two gases combine with a loud explosion when exposed to the actinic rays of the spectrum. Another curious fact mentioned is that a spark of positive electricity does not effect their combination, which is only determined by a negative spark. If confirmed, this is without doubt the greatest chemical discovery ever made, and we shall present our readers with the memoir as soon as we can obtain it from Munich, to the Royal Society of which city the author has communicated his discovery.

**Failure of the Metropolitan Gas Regulation Act.**—We are sorry to see that the first prosecution instituted under this Act has failed from an apparent oversight of the framers of the Act. The prosecution was instituted by the City Sewers' Commission, of which it seems all the aldermen are members by virtue of their office. Consequently, it is held that no alderman can hear a complaint made by the Commission. This state of things we should hope would be remedied at once. The lighting of our streets and houses in some districts of London is at present disgraceful. A person compelled to walk through some localities after the shops and public houses are closed, now finds a condition of things which can hardly be better than in the old days of oil lighting. The Gas Regulation Act was a great legislative mistake,

but its complete failure in improving or even maintaining the quality of the gas supplied by the companies must be ascribed to causes into which we dare not particularly enter. But we have no hesitation in saying that district Medical officers of health, sometimes in large practice, can hardly have time to devote to the duties of a gas inspectorship, even if they had the knowledge to qualify them for the post.

**Arborisations Produced by Sulphate of Copper in Solutions of Alkaline Silicates.**—By placing a few crystals of sulphate of copper or iron in a very diluted solution of silicate of potash, a mineral vegetation is formed in a few hours, of the same colour as the sulphate employed; this arborisation is remarkable, as it seems to reproduce in the solution of silica the mossy appearance seen in agates; by attentively following its growth some curious phenomena are observable. The stalks very often rise in the form of an arch; this takes place when the solution is at a certain degree of saturation; if it is very much diluted the arborescence rises vertically and in a straight line. If it is too much concentrated no arborisation takes place, the sulphate of copper merely becomes covered with a black coating. But in a properly dense solution a curious fact is observable; after the formation of the vertical stalks, fresh branches form upon them, inclining horizontally at an angle which is the same for all in the same solution. In solutions of different densities the most concentrated gives to these branches the most acute angle. What can be the cause of this regularity in the incline of such tenuous fibres? This problem is certainly as yet unresolved, but until it be resolved we hazard the following explanation:—The helicoidal form of certain fibres sufficiently indicates that they are arrested in their development by the density of the liquid, they then curve in the line which most easily enables them to overcome this resistance; but there must be another cause for those fibres which follow an oblique line always equally inclined, for they evidently follow this direction on account of the slight resistance thus offered to their development. The reason for this appears to exist in a kind of invisible cleavage possessed by the solution; if it be admitted that this cleavage exists according to a rhombohedral, as silica belongs to this system, all will be explained, for the terminal edges as well as the faces of this form are inclined horizontally. The arborisation produced by this experiment is very curious, for in the space of one day a prepared solution may be filled with vegetation varied according to the sulphate employed, and presenting an exact miniature representation of a forest. To render the experiment more interesting the bottom of the glass jar may be strewn with well-washed sand, and the addition of a few pieces of bichromate of potash will give to this the natural colour of soil, and parts of it powdered over with sulphate of copper will have the appearance of grass. It is hardly necessary to add that the vessel should never be moved when once the experiment is commenced.—*Les Mondes*, vii., 344.

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

S. M.—You will find a good deal of information on the subject in Cooley's "Dictionary of Practical Receipts." We know of no book exclusively devoted to the subject.

Jeremiah.—A "Doctor" may be anything he pleases. We have known one a crossing-sweeper, who made more by the handle of his broom than the handle to his name. The gentleman is the member of a wealthy city firm.

F. C. S.—To the several correspondents who have addressed us under this signature, we can only say that the matter is one upon which we are obviously precluded from expressing an opinion. Country members cannot vote unless present.

Received.—R. R.; G. G.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.

## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION I.—Historical Development of the Ideas, Equivalent, Atom, Molecule.

(Continued from page 110.)

#### Gerhardt's Atomic Weights and Notation.—

Gerhardt returned to the atomic notation, but he introduced important modifications into it. At first he met with the inconveniences of the system of equivalents when he attempted to formulate the composition and reactions of organic bodies. By adopting for carbon, hydrogen, and oxygen the equivalents 6, 1, and 8, the formulæ of organic compounds became such that the number of equivalents of carbon was always divisible by two; or, in other words, the organic molecules always increased by double equivalents of carbon; moreover, when these molecules were destroyed, or by any energetic action lost carbon as carbonic acid, or hydrogen as water, there was never disengaged one equivalent of carbonic acid  $\text{CO}_2$ , or one equivalent of water  $\text{HO}$ , but two, or a multiple of two equivalents of carbonic acid or water.

Gerhardt was led to this strange result of equivalent notation. Why, said he, should no reaction of organic chemistry give rise to one equivalent of carbonic acid or one of water? This is apparently caused by some fault committed in the determination of the atomic weight of carbon and of oxygen. In fact, if the smallest quantity of carbonic acid which is produced by one molecule is  $\text{C}_2\text{O}_4$ , this amount undoubtedly represents one molecule of carbonic acid. This, therefore, contains 12 of carbon and 32 of oxygen, and it will be more convenient to represent this by the formula  $\text{CO}_2$ , in which C represents 12 of carbon and O 16 of oxygen. On the other hand, if the smallest quantity of water produced by a reaction is  $\text{H}_2\text{O}_2$ , this quantity represents a molecule of water, and it had better be expressed by the formula  $\text{H}_2\text{O}$ , in which H represents 1 of hydrogen and O 16 of oxygen. This was returning to the atomic weights given by Berzelius for hydrogen, oxygen, and carbon; for the numbers 1; 16; 12 are proportional to the numbers 6·28; 100; 75. It was likewise coming back to the atomic notation which is founded on the considerations of volumes—that is to say, to the law of Gay-Lussac. To my mind, Gerhardt did not insist on this double characteristic. If he had invoked in favour of the reform he was endeavouring to inaugurate the two great names of Gay-Lussac and Berzelius, he would have easily quieted the mistrust of some and the opposition of others. "See," a diplomatist would have said, "I am returning to the notation with which you have been quite familiar; I merely introduce to it certain changes rendered necessary by the progress of science." But the strength of his conviction and the warmth of his character led him to less moderate and admissible expressions.

In fact, the alterations in the system of atomic weights and of notation which he introduced into Berzelius' notation were really insignificant. Like him, he doubled the equivalents of hydrogen, chlorine, bromine, iodine, fluorine, nitrogen, phosphorus, and arsenic

to convert them into atomic weights.\* But he extended to the metals themselves this reduction of the equivalents to one half. Adopting and developing an idea first started by Laurent, he compared the oxides,  $\text{RO}$ , with water, and assumed that they contained two atoms of metal to one of oxygen. The density of mercury vapour (6·9) compared with that of oxygen (1·1056) furnished him with a powerful argument in favour of this theory. To form oxide of mercury would require two volumes of mercury vapour and one volume of oxygen, for

$$\frac{2 \times 6.9}{1.1056} \text{ is practically } = \frac{100}{8}.$$

If the atomic weight of oxygen is 8, that of mercury would be 50, and the formula of oxide of mercury  $\text{Hg}_2\text{O}$ . Analogy leads to classifying the other protoxides under the general formula  $\text{R}_2\text{O}$ , and to doubling the equivalents of the metals contained in them.

Such are the fundamental points of Gerhardt's system of atomic weights, and of the notation which springs from it.

For certain bodies this notation is similar to that of Berzelius, but for others it is very different. In all cases it is developed from an obvious consequence of the theory of volumes. With few exceptions the formulæ of volatile compounds answer to two volumes of vapour. In the notation of Berzelius, the same formulæ answer sometimes to two, sometimes to four, volumes of vapour, as may be seen by the following table:—

Names of the Compounds. Berzelius's Notation. Gerhardt's Notation.

Water . . . . .	$\text{H}_2\text{O}$	= 2 vols.	$\text{H}_2\text{O}$	= 2 vols.
Sulphuretted hydrogen	$\text{H}_2\text{S}$	= 2 vols.	$\text{H}_2\text{S}$	= 2 vols.
Hydrochloric acid . . .	$\text{H}_2\text{Cl}_2$	= 4 vols.	$\text{HCl}$	= 2 vols.
Hydriodic acid . . . .	$\text{H}_2\text{I}_2$	= 4 vols.	$\text{HI}$	= 2 vols.
Ammonia . . . . .	$\text{N}_2\text{H}_6$	= 4 vols.	$\text{NH}_3$	= 2 vols.
Phosphuretted hydrogen	$\text{P}_2\text{H}_6$	= 4 vols.	$\text{PH}_3$	= 2 vols.
Arseniuretted hydrogen	$\text{As}_2\text{H}_6$	= 4 vols.	$\text{AsH}_3$	= 2 vols.
Hypochlorous acid gas .	$\text{Cl}_2\text{O}$	= 2 vols.	$\text{Cl}_2\text{O}$	= 2 vols.
Hypochloric acid gas .	$\text{Cl}_2\text{O}_4$	= 4 vols.	$\text{ClO}_2$	= 2 vols.
Protoxide of nitrogen .	$\text{N}_2\text{O}$	= 2 vols.	$\text{N}_2\text{O}$	= 2 vols.
Binoxide of nitrogen .	$\text{N}_2\text{O}_2$	= 4 vols.	$\text{NO}$	= 2 vols.
Hyponic acid . . . . .	$\text{N}_2\text{O}_4$	= 4 vols.	$\text{NO}_2$	= 2 vols.
Nitric acid $\text{N}_2\text{O}_5, \text{H}_2\text{O} =$	$\text{N}_2\text{H}_5\text{O}_6$	= 4 vols.	$\text{NHO}_3$	= 2 vols.
Nitrates $\text{N}_2\text{O}_5, \text{RO} =$	$\text{N}_2\text{RO}_6$	—	$\text{NRO}_3$	—
Anhydrous sulph. acid	$\text{SO}_3$	= 2 vols.	$\text{SO}_2$	= 2 vols.
Sulph. acid $\text{SO}_3, \text{HO}_2 =$	$\text{SH}_2\text{O}_4$	—	$\text{SH}_2\text{O}_4$	—
Sulphates $\text{SO}_3, \text{RO} =$	$\text{SRO}_4$	—	$\text{SR}_2\text{O}_4$	—
Carbonic oxide . . . .	$\text{CO}$	= 2 vols.	$\text{CO}$	= 2 vols.
Carbonic acid . . . . .	$\text{CO}_2$	= 2 vols.	$\text{CO}_2$	= 2 vols.
Carbonates $\text{CO}_2, \text{RO} =$	$\text{CRO}_3$	—	$\text{CR}_2\text{O}_3$	—
Cyanogen . . . . .	$\text{C}_2\text{N}_2$	= 2 vols.	$\text{C}_2\text{N}_2$	= 2 vols.
Hydrocyanic acid . . .	$\text{C}_2\text{N}_2\text{H}_2$	= 4 vols.	$\text{CNH}$	= 2 vols.
Acetic acid . . . . .	$\text{C}_4\text{H}_8\text{O}_4$	= 4 vols.	$\text{C}_2\text{H}_4\text{O}_2$	= 2 vols.
Alcohol . . . . .	$\text{C}_4\text{H}_{12}\text{O}_4$	= 4 vols.	$\text{C}_2\text{H}_6\text{O}$	= 2 vols.
Ether . . . . .	$\text{C}_4\text{H}_{10}\text{O}$	= 2 vols.	$\text{C}_4\text{H}_{10}\text{O}$	= 2 vols.

A comparison of these two systems of formulæ will

\* Gerhardt said:—We must either double the equivalents of hydrogen, chlorine, bromine, iodine, fluorine, nitrogen, phosphorus, arsenic, and the metals, or else we must retain the ordinary equivalents for these, and double those of oxygen, carbon, sulphur, and selenium. In either case we get the same result. This will be seen by looking at the following table, in which are given the numbers obtained in each of these two cases:—

	H.	Cl.	Br.	I.	N.	P.	As.	K.	Hg.	O.	C.	S.	Se.
Equivalents	1	35.5	80	127	14	31	75	39	100	8	6	16	40
Atomic weights	I. 1	17.75	40	63.5	7	15.5	37.5	18.5	50	8	6	16	40
	II. 1	35.5	80	127	14	31	75	39	100	16	12	32	80

Gerhardt thought that it would be more convenient to adopt the latter numbers, compared with hydrogen taken as unity. He called these numbers equivalents, out of habit, no doubt, for they are not really equivalents, as Gmelin well remarked in 1844 (*Handbuch*, 4th Ed., iv., 26). But in such a case as this, an error of language does not detract from the value of the ideas,



give rise to some important remarks. The proportion between the atomic weights of hydrogen, oxygen, nitrogen, chlorine, and carbon being the same in the two notations, it is evident, in the first place, that the formulæ of bodies containing these elements should be identical whenever they are represented by two volumes; in the second place, that the formulæ of Berzelius should be double Gerhardt's formulæ whenever the first represent four volumes. Thus, the formula by which Berzelius represented the composition of nitric acid is exactly double Gerhardt's formula.

It may be asked—why should the founder of atomic notation prefer these doubled formulæ corresponding to 4 volumes of vapour, to simple formulæ which would refer all volatile compounds, with few exceptions, to the same volume? He had good reasons for that. He considered that compound bodies were always formed by the addition of their elements, so that in any combination each of its ingredients occupied a distinct place. According to him, combinations might be more or less complicated, but they would always contain two elementary parts (either simple or compound) which would be in juxtaposition, and, as it were, opposed to one another. Chemical affinity would result from this opposition between two contrary forces always tending to neutralise each other; and these opposing forces which govern chemical combinations were of the nature of electricity. There are two electric fluids: every combination should therefore contain two halves—one electro-positive, the other electro-negative. Such is in a few words the system of Berzelius; the compound dualism of the electro-chemical theory.

It is now seen why Berzelius represented nitric acid by the formula  $N_2O_5, H_2O$ . In his view it was a combination of the second order, containing integrally all the elements of nitric acid on the one side, and all the elements of water on the other. The first constituted the electro-positive, the second the electro-negative element. To divide such a formula in half was to strike at the foundation of his system, for in the simplified formula there would neither be found the elements of water nor those of anhydrous nitric acid.

Again, nitrates would contain unchanged the elements both of nitric acid, and of the oxide, and if Berzelius had adopted half the atomic weights for the metals he would have written the nitrates  $N_2O_5, R_2O$ . His ideas would forbid him to simplify this or any analogous formula.

Modern chemistry has changed all that. The discovery of substitutions struck the first blow at the electro-chemical theory. This memorable discussion will long be remembered, in which a comparatively young chemist had the temerity to oppose his new theory in opposition to the one which had stood its ground for twenty years.

Chemists will recall that famous discussion in which Dumas proved conclusively that chlorine, an electro-negative element, could replace hydrogen, an electro-positive element; that chlorine could enter into organic molecules otherwise than by molecular addition. This was the commencement of the new chemistry.

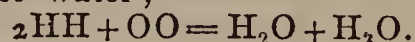
Gerhardt commenced by saying:—"Combinations do not take place by molecular addition; everything is effected by substitution." The basis of this idea lies in an hypothesis formerly started by Ampère concerning the combination of chlorine with hydrogen. He regarded the formation of hydrochloric acid as due to a double decomposition. If, said he, 2 volumes of chlorine, representing 2 atoms, combine with 2 volumes of hydrogen, likewise representing 2 atoms, to form 4 volumes of

hydrochloric acid, it is evident that 2 volumes of this acid should contain 1 volume or an atom of chlorine, and the 2 other volumes the other atom of chlorine; and the same in the case of the hydrogen. It is then evident that there has been a change between the atoms of hydrogen and of chlorine, that is to say, a double decomposition;

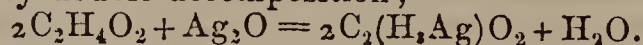


M. Dumas expressed the same thing under another form when he said that in the combination of hydrogen and chlorine the *physical* atoms of these bodies divided in two.† M. Dumas termed physical atoms what Gerhardt designated by the name of molecules. One molecule of chlorine contains two atoms and corresponds with two volumes. Free chlorine, according to Gerhardt, is chloride of chlorine; free hydrogen is hydride of hydrogen. A molecule of hydrochloric acid (HCl) contains, therefore, as many atoms as a molecule of hydrogen (HH), and if a molecule of hydrocyanic acid is HCy, a molecule of cyanogen must be represented by CyCy. Free cyanogen is, therefore, cyanide of cyanogen.

Thus, not only do the molecules of compound bodies correspond to two volumes, but the molecules of simple bodies themselves are in the same case. In their molecular complication these latter approach the nature of compound bodies, except that the elementary atoms they contain are of the same kind. Simple bodies can therefore undergo double decomposition the same as compound bodies. In all chemical reactions it is the molecules which enter into collision and exchange their atoms in such a manner as to give rise to new molecules. When hydrogen combines with oxygen it attacks a molecule of oxygen, which being defeated, becomes converted into two molecules of water;



In the same manner, the combination of acids with bases depends upon double decomposition. When acetic acid combines with oxide of silver there is an exchange of elements between two molecules of acid and one molecule of oxide of silver: water and acetate of silver are formed by double decomposition;



Thus acetate of silver does not contain, as Berzelius imagined, all the elements of a molecule of oxide of silver. It contains a single atom of silver, which is substituted for a single atom of hydrogen in a molecule of acetic acid.

Such are the ideas which are intimately connected with Gerhardt's system of atomic weights and notation, and which have led to a distinct separation between the notion of atoms and that of molecules.

An *atom* is the smallest quantity of an element, indivisible by chemical means, which can exist in a compound body.

A *molecule* is a group of atoms, forming the smallest quantity of a simple or compound body which can exist in a free state, or is able to take part in, or result from, a reaction.

(To be continued.)

#### On the Occurrence of Crystallised Melaconite in Cornwall, by A. H. CHURCH.

PURE cupric oxide or melaconite is by no means of frequent occurrence. The volcanic variety of it, tenorite, is far from pure, while the earthy form, kupferswärze, often contains less than half its weight of cupric oxide. I examined, a few years ago, some earthy black copper



from Cornwall. It was associated with cuprite, and contained only 6.27 per cent. of impurities, but no indications of crystals could be traced in it. Mr. Talling, however, has just forwarded to me for examination some beautiful crystals of melaconite, which quantitative analysis has proved to be remarkably pure. The specimens are from Cornwall. The crystals are brilliant, dark steel grey, opaque, and show a shining streak; they give a velvet black powder when finely ground. Their hardness is greater than that of calcite, less than that of fluor; their density is above 6. The cleanest and finest groups of crystals being reserved for measurement, the portion devoted to analysis was known to be mixed with a small proportion of gangue, but it nevertheless gave very satisfactory results. It should be stated that the mineral dissolves readily in warm hydrochloric acid, and that no cuprous salt could be detected in the solution. In another specimen a trace of cuprous chloride was found, but in that case a few minute crimson cubes of cuprite were seen under the microscope.

*Analysis of Melaconite.*

- I. .609 grm. gave .475 grm. Cu (by Pfaff's method).  
II. .609 „ „ .6005 „ CuO  
III. .609 „ „ .0105 „ Gangue.

These results lead to the following mean percentages:

	I.	II.	III.
Cupric oxide.	97.63	98.61	—
Gangue.	—	—	1.72

Deducting gangue, the theoretical and experimental percentages are as follows:—

	Theory, CuO.	Experiment.
		I. II.
Copper .	79.75	79.35
Oxygen .	20.25	(19.99)
	100.00	99.34

R. A. College, Cirencester, March 13.

*On the Theory of Types in Chemistry,\**  
by T. STERRY HUNT, M.A., F.R.S.

IN the *Annalen der Chemie und Pharmacie* for March, 1860 (cxiii., 293), Mr. Kolbe has given a paper on the natural relations between mineral and organic compounds, considered as a scientific basis for a new classification of the latter. He objects to the four types admitted by Gerhardt—namely, hydrogen, hydrochloric acid, water, and ammonia—that they sustain to organic compounds only artificial and external relations, while he conceives that between these and certain other bodies there are natural relations having reference to the origin of the organic species. Starting from the fact that all the bodies of the carbon series found in the vegetable kingdom are derived from carbonic acid with the concurrence of water, he proceeds to show how all the compounds of carbon, hydrogen, and oxygen may be derived from the type of an oxide of carbon, which is either  $C_2O_4$ ,  $C_2O_2$ , or the hypothetical  $C_2O$ .

When in the former we replace one atom of oxygen by one of hydrogen we have  $C_2O_3H$ , or anhydrous formic acid; the replacement of a second equivalent would yield  $C_2O_2H_2$ , or the unknown formic aldehyde; a third,  $C_2OH_3$ , the oxide of methyle; and a fourth,  $C_2H_4$ , or formene. By substituting methyle for one or more atoms of hydrogen in the previous formula, we obtain those of the corresponding bodies of the vinic series,

and it will be readily seen that by introducing the higher alcoholic radicals we may derive from  $C_2O_4$  the formulas of all the alcoholic series. A grave objection to this view is, however, found in the fact that while this compound may be made the type of the aldehydes, acetones, and hydrocarbons, it becomes necessary to assume the hypothetical  $C_2O_2HO$  as the type of the acids and alcohols. Oxide of carbon,  $C_2O_2$ , is, according to Kolbe, to be received as the type of hydrocarbons, like olefiant gas ( $C_2HMe$ ), while  $C_2O$ , in which ethyle replaces oxygen, is  $C_6H_5$ , or lipyle, the supposed triatomic base of glycerine.

The monobasic organic acids are thus derived from one atom of  $C_2O_4$ , while the bibasic acids, like the succinic, are by Kolbe deduced from a double molecule,  $C_4O_8$ , and tribasic acids, like the citric, from a triple molecule,  $C_6O_{12}$ . He moreover compares sulphuric acid to carbonic acid, and derives from it by substitution the various sulphuric organic compounds. Ammonia, arseniuretted, and phosphuretted hydrogen are regarded as so many types; and by an extension of his view of the replacement of oxygen by electro-positive groups, the ethylids  $ZnEt$ ,  $PbEt_2$ , and  $BiEt_3$ , are by Kolbe assimilated to the oxides of  $ZnO$ ,  $PbO_2$ , and  $BiO_3$ .

Ad. Wurtz, in the *Repertoire de Chimie Pure* for October, 1860, has given an analysis of Kolbe's memoir (to which, not having the original before me, I am indebted for the preceding sketch), and follows it by a judicious criticism. While Kolbe adopts as types a number of mineral species, including the oxides of carbon, of sulphur, and the metals, Wurtz would maintain but three, hydrogen ( $H_2$ ), water ( $H_2O_2$ ), and ammonia ( $NH_3$ ); and these three types, as he endeavoured to show in 1855, represent different degrees of condensation of matter. The molecule of hydrogen,  $H_2(M_2)$ , corresponding to four volumes, combines with two volumes of oxygen ( $O_2$ ) to form four volumes of water, and may thus be regarded as condensed to one-half in its union with oxygen, and derived from a double molecule,  $M_2M_2$ . In like manner four volumes of ammonia contain two volumes of nitrogen and six of hydrogen, which, being reduced to one-third, correspond to a triple molecule,  $M_2M_3$ , so that these three types and their multiples are reducible to that of hydrogen more or less condensed.—(Wurtz, *Annales de Chimie et de Physique* (3) xliv. 304.

As regards the rejection of water as a type of organic compounds, and the substitution of carbonic acid, founded upon the consideration that these in nature are derived from  $C_2O_4$ , Wurtz has well remarked that water, as the source of hydrogen, is equally essential to their formation, and, indeed, that the carbonic anhydrid  $C_2O_4$ , like all other anhydrous acids, may be regarded as a simple derivative of the water type. Having, then, adopted the notion of referring a great variety of bodies to a mineral species of simple constitution, water is to be preferred to carbonic anhydrid, first, because we can compare with it many mineral compounds which can with difficulty be compared with carbonic acid; and secondly, because the two atoms of water being replaceable singly, the mode of derivation of a great number of compounds (acids, alcohols, ethers, &c.) is much more simple and natural than from carbonic acid. As Wurtz happily remarks, Kolbe has so fully adopted the theory of types that he wishes to multiply them, and even admits condensed types, which are, however, molecules of carbonic acid, and not of water; "he combats the types of Gerhardt, and at the same time counterfeits them."

\* We willingly reprint this article at the request of the learned author, who is reasonably anxious that his own share in the development of the ideas now generally received should not be overlooked.—ED. C.N.



Thus far we are in accordance with Mr. Wurtz, who has shown himself one of the ablest and most intelligent expounders of this doctrine of molecular types, as above defined, now almost universally adopted by chemists. He writes:—"To my mind this idea of referring to water, taken as a type, a very great number of compounds, is one of the most beautiful conceptions of modern chemistry."—(*Repertoire de Chimie Pure*, 1860, p. 359); and again, he declares the idea of regarding both water and ammonia as representatives of the hydrogen type, more or less condensed, to be so simple and so general in its application that it is worthy "to form the basis of a system of chemistry."—(*Ibid.*, p. 356.)

We have in this theory two important conceptions: the first is that of hydrogen and water regarded as types to which both mineral and organic compounds may be referred; and the second is the notion of condensed and derived types, according to which we not only assume two or three molecules of hydrogen or water as typical forms, but even look on water as the derivative of hydrogen, which is itself the primal type.

As to the history of these ideas, Wurtz remarks that the proposition enunciated by Kolbe that all organic bodies are derived by substitution from mineral compounds is not new, but known in the science for about ten years. "Williamson was the first who said that alcohol, ether, and acetic acid were comparable to water—organic waters. Hofmann and myself had already compared the compound ammonias to ammonia itself." . . . "To Gerhardt belongs the merit of generalising these ideas, of developing them, and supporting them with his beautiful discovery of anhydrous monobasic acids. Although he did not introduce into the science the idea of types, which belongs to M. Dumas, he gave it a new form, which is expressed and essentially reproduced by the proposition of Kolbe. Gerhardt reduced all organic bodies to four types—hydrogen, hydrochloric acid, water, and ammonia."—(*Ibid.*, p. 355.)

The historical inaccuracies of the above quotation are the more surprising since in March, 1854, I published in the *American Journal of Science*, (xvii., 194) a concise account of the progress of these views. This paper was re-published in the *Chemical Gazette* (1854, p. 181), and copies of it were by myself placed in the hands of most of the distinguished chemists of England, France, and Germany. In this paper I have shown that the germ of the idea of mineral types is to be found in an essay of Auguste Laurent (*Sur les Combinaisons Azotées*, *Ann. de Chimie et Physique*, Nov., 1860), where he showed that alcohol may be looked upon as water ( $H_2O_2$ ) in which ethyle replaces one atom of hydrogen, and hydric ether as the result of a complete substitution of the hydrogen by a second atom of ethyle. Hence he observed that while ether is neutral, alcohol is monobasic, and the type of the monobasic vinic acids, as water is the type of bibasic acids. In extending and developing this idea of Laurent's, I insisted in March, 1848, and again in January, 1850, upon the relation between the alcohols and water as one of homology, water being the first term in the series, and  $H_2$  being in like manner the homologue of acetene and fermeine, while the bases of Wurtz were said to "sustain to their corresponding alcohols the same relation that ammonia does to water."—(*Am. Jour. Sci.*, v., 265; ix., 65; xiii., 206.)

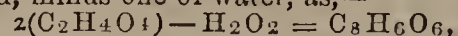
In a notice of his essay, published in September, 1848, (*Ibid.*, vi., 173) I endeavoured to show that Laurent's view might be farther extended, so as to include in the type of water "all those saline combinations (acids) which contain oxygen;" and in a paper read before the

American Association for the Advancement of Science at Philadelphia, in September, 1848, I further suggested that as many neutral oxygenised compounds which do not possess a saline character are derivatives of acids which are referable to the type  $H_2O_2$ , "we may regard all oxygenised bodies as belonging to this type," which I further showed in the same essay is but a derivative of the primal type  $H_2$ , to which I referred all hydrocarbons and their chlorinised derivatives, as also the volatile alkaloids, which were regarded "as amidised species" of the hydrocarbons, in which the residue amidegen,  $NH_2$ , replaced an atom of H or Cl, or, what is equivalent, the residue NH was substituted for  $O_2$  in the corresponding alcohols. (*Ibid.* viii., 92).

In the paper published in September, 1848, I showed that while water is bibasic, the acids which like hypochlorous and nitric acids were derived from it by a simple substitution of Cl and  $NO_4$  for H, were necessarily monobasic, and I then pointed out the possible existence of the nitric anhydride  $(NO_4)_2O_2$ , which was soon after discovered by Deville. Gerhardt at this time denied the existence of anhydrides of the monobasic acids, while he regarded anhydrides as characteristic of polybasic acids, and, indeed, was only led to adopt my views by the discovery of the very anhydrides whose formation I had foreseen.†

In explaining the origin of bibasic acids I described them as produced by the replacement, in a second equivalent of water, of an atom of hydrogen by a monobasic saline group; thus sulphuric acid would be  $(S_2HO_6H)O_2$ . Tribasic acids in like manner are to be regarded as derived from a thirdequivalent of water in which a bibasic residue replaces an atom of hydrogen. The idea of polymeric types was further illustrated in the same paper, where three hydrogen types were proposed  $(HH)$ ,  $(H_2H_2)$  and  $(H_3H_3)$  corresponding to the chlorides  $MCl$ ,  $MCl_2$ , and  $MCl_3$ . It was also illustrated by sulphur in its ordinary state, which I showed is to be regarded as a triple molecule  $S_3$  (or  $S_6=4$  volumes) and referred sulphurous acid  $SO_2$  to this type, to which also probably belongs selenic oxide. (At the same time I suggested that the odorant form of oxygen or ozone was possibly  $O_3$ .) Wurtz in his memoir, published in 1855, adopts my view, and makes sulphur vapour at  $400^\circ C$ . the type of the triple molecule. I further suggested (*American Journal of Science*, v. 408, vi. 172,) that gaseous nitrogen is  $NN$ , an anhydride amide or nitryl, corresponding to nitrite of ammonia,  $(NO_3, NH_4O) - H_4O_4 = NN$ . This view a late writer attributes to Gerhardt, who adopted it from me (*Ann. der Chemie et Phys.*, lx. 381). May not nitrogen gas, as I have elsewhere suggested, regenerate under certain conditions, ammonia and a nitrite, and thus explain not only the frequent formation of ammonia in presence of air and reducing agents, but certain cases of nitrification? ‡

† The anhydrides of the monobasic acids correspond to two equivalents of the acid, minus one of water, as,—



while one equivalent of a bibasic acid (itself derived from  $2(H_2O_2)$ ) loses one of water, an anhydride, as— $C_2H_2O_6 - H_2O_2 = C_2O_4$ . So that both classes of anhydrides are to be referred to the type of one molecule of water,  $H_2O_2$ .

‡ The formation of a nitrite in the experiments of Cloez appears to be independent of the presence of ammonia, and to require only the elements of air and water (*Comptes Rendus*). Some experiments now in progress lead me to conclude that the appearance of a nitrite in the various processes for ozone, is due to the power of nascent oxygen to destroy by oxidation the ammonia generated by the action of water on nitrogen, the nitrous nitryl; so that the odour and many of the reactions assigned to ozone or nascent oxygen are really due to the nitrous acid which is set free when the former encounters nitrogen and moisture. On the other hand, nascent hydrogen, which readily reduces nitrates and nitrites to ammonia, by destroying the regenerated nitrite of the nitryl, produces ammonia in many cases from atmospheric nitrogen.



I endeavoured still further to show that hydrogen is to be looked upon as the fundamental type from which the water type is derived by the replacement of an atom of H by the residue  $\text{HO}_2$  (*American Journal*, viii., 93.) In the same way I regarded ammonia as water in which the residue NH replaced  $\text{O}_2$ .

I have always protested against the view which regards the so-called rational formulæ as expressing in any way the real structure of the bodies which are thus represented. These formulæ are invented to explain a certain class of reactions, and we may construct from other points of view other rational formulæ which are equally admissible. As I have elsewhere said, "the various hypotheses of copulates and radicals are based upon the notion of dualism, which has no other foundation than the observed order of generation, and can have no place in a theory of science." All chemical changes are reducible to union (identification), and division (differentiation). When in these changes only one species is concerned, we designate the process as metamorphosis, which is either by condensation or by expansion (homogeneous differentiation). In metagenesis, on the contrary, unlike species may unite, and by a subsequent heterogeneous differentiation give rise to new species, constituting what is called double decomposition, the results of which, differently interpreted, have given origin to the hypothesis of radicals and the notion of substitution by residues to express the relations between the parent bodies and their progeny. The chemical history of bodies is, then, a record of their changes. It is, in fact, their genealogy, and in making use of typical formulæ to indicate the derivation of chemical species we should endeavour to show the ordinary modes of their generation. (See "On the Theory of Chemical Changes," *Am. Jour. Sci.* xv. 226, L. E. and D. *Phil. Mag.* (4) v. 526, and *Chem. Centralblatt*, 1853, p. 849. Also "Thoughts on Solution," *Am. Jour. Sci.*, xix. 100, and *Chemical Gazette*, 1855, p. 92.)

(To be continued.)

#### On the Solubility of the Sulphate of Baryta in Sulphuric Acid, by Professor J. NICKLES.

THE sulphates of baryta, strontia, and lime, are slightly soluble, as is known, in boiling sulphuric acid. I have found that they are soluble in cold acid when in a nascent state.

To obtain this result it is only necessary to throw a little chloride of barium or of strontium into a sufficient quantity of mono-hydrated acid; the chloride is by degrees decomposed, chlorhydric acid escapes, and the sulphate produced dissolves in the surrounding acid.

This is especially true for the chloride of barium; but to succeed the acid should be concentrated, and it is best to have the chloride well dried and in powder. On adding water to the solution thus obtained, the sulphate of baryta falls as a white precipitate.

The chloride of strontium gives the same results, and the acid solution affords a similar precipitate with water, though less in amount since less is dissolved.

The sulphate of lime is still less soluble in sulphuric acid, and the solution takes several days to become limpid. Moreover, water does not then becloud it. A light precipitate is obtained with alcohol.

The solubility of the sulphates in sulphuric acid is then the reverse of their solubility in water, except for the sulphate of strontium, which, in both cases, is a mean between those of the other two.—*Ann. Jour. Science and Arts*, Vol. xxxix., No. 115.

#### On the Separation of Cobalt from Nickel, by WOLCOTT GIBBS, M.D.

A METHOD of separating these metals, given some years since by Liebig,\* consists in boiling the mixed double cyanides of nickel and potassium and cobalt and potassium with oxide of mercury. Oxide of nickel is precipitated while an equivalent quantity of mercury is dissolved as cyanide. The method certainly gives good results, but is not free from objection. Long boiling is necessary before the precipitation is complete, and it is difficult to prevent bumping during ebullition. The excess of oxide of mercury must be separated from the oxide of nickel by a special operation, and the nickel afterwards again precipitated by caustic alkali.

These inconveniences may be completely avoided by employing, instead of the oxide alone, a solution of the oxide in the cyanide of mercury. When this solution is added to a hot solution of the double cyanide of nickel and potassium, the whole of the nickel is immediately thrown down as a pale green hydrate of the protoxide. Under the same circumstances cobalt is not precipitated from the double cyanide of cobalt and potassium. Mr. W. N. Hill, who has repeatedly employed this method and carefully tested it, has found that the separation effected is complete. No cobalt can be detected in the precipitated oxide of nickel by the blowpipe, nor can the nickel be detected in the cobalt (finally separated as oxide) by Plattner's process with the gold bead. The solution of oxide of mercury is easily obtained by boiling the oxide with a strong solution of the cyanide, and filtering. According to Kuhn,† the cyanide formed in this manner has the formula  $\text{HgCy} + 3\text{HgO}$ . The hydrated oxide of nickel precipitated may be filtered off, washed, dried, ignited, and weighed. The cobalt is more readily and conveniently determined by difference, when, as it is always possible, the two metals have been weighed together as sulphates. I am not prepared to say that this modification of Liebig's method of separating nickel and cobalt gives better results than Stro-meyer's process by means of nitrite of potassium, but it is at least very much more convenient, and requires much less time. The complete precipitation of cobalt in the form of  $\text{CO}_2\text{O}_{33}2\text{NO}_3 + 3\text{KONO}_3$  usually requires at least forty-eight hours, and rarely succeeds perfectly except in experienced hands.—*American Journal of Science and Art*, January, 1865.

#### On Catechine,‡ by MM. KRAUT and Van DELDEN.

THE authors in the first place confirm the composition which M. Neubauer deduced from his analyses of catechine, and they agree with him in admitting that it is not a glucoside. After being dried at  $100^\circ$  in a current of hydrogen gas its formula is  $\text{C}_{24}\text{H}_{12}\text{O}_{10}$ .

A boiling solution of catechine in alcohol, traversed by a current of hydrogen, saturated with hydrochloric gas, forms, in about two hours, a mass of crystals constituting catechuretine, which dried in the air gives the composition  $26\text{C}_{24}\text{H}_{10}\text{O}_8 + 7\text{HO}$ . At  $100^\circ$  in a current of hydrogen, it loses 14.51 per cent. of water; theoretically it should be 12.6.

With bromine water catechine gives bromated catechuretine  $\text{C}_{24}\text{Br}_4\text{H}_6\text{O}_8$ . According to the above, catechuretine would be an isomer of piperic acid.

MM. Schutzenberger and Rack have recently arrived at almost identical results, and at the same time they made known some new derivatives, such as benzoate of catechine.

\* *Ann. der Chemie und der Pharmacie*, lxx., 244.

† Berzelius, "Lehrbuch der Chemie," iii., 872.

‡ *Ann. hem. Pharm.*, lii., 285.



*Purification of Rough Paraffine,\* by M. KLETZINSKY.* CRUDE paraffine contaminated with various empyreumatic oils is refined and purified by various processes, either by means of the centrifugal machine or by sulphuric acid. Various attempts to discover some simpler means of refining have led to the two following processes:—

About 10 per cent. of powdered hypochlorite of lime is incorporated with the crude melted paraffine; the mass becomes white and disengages oxygen. Pour it into some diluted hydrochloric acid, and boil the whole until all the paraffine rises to the surface.

The second process consists in heating the rough paraffine with ten times its volume of amylic alcohol, and filtering while hot. The tar-like matter remains on the filter, the oils remain in solution while the pure paraffine separates on cooling. It is then in the form of nacreous flakes, and is pressed, triturated once or twice with cold amylic alcohol, again pressed, washed with amylic alcohol, and melted. The product constitutes pure paraffine.

#### *Note on Chrome Alum, by GEORGE GATHERAL.*

THE conversion of violet-chrome alum into the green uncrystallisable variety by the action of heat is well known, but the following observation of the change from the green to the violet form by exposure to cold, is, I believe, new:—A large quantity of chrome alum having been made at the Mechanics' Institution Laboratory, the various mother liquors were boiled up to a syrupy consistence, placed in a bottle and laid aside.

The solution had a pure and intense green colour and retained its fluidity for several months. After exposure for several days to rather intense cold, however, the bottle was observed to be full of a solid body, consisting of minute crystals of ordinary violet-chrome alum. Upon dissolving in tepid water, crystallising and evaporating the mother liquor, nearly the whole of the alum was obtained in crystals. A dilute solution of green-chrome alum, prepared about a year since, has also become changed in great part, but whether the conversion has been gradual, or whether it occurred during the late cold weather, I am unable to say.

Glasgow, March 7, 1865.

#### *On the Colouring Matter of Fustic,† by MM. BOLLEY and MYLIUS.*

FUSTIC, called also Hungarian fustic, is the wood of the *Rhus cotinus* freed from sap and bark, and is imported from Dalmatia, Hungary, Illyria, the south of the Tyrol, and from Spain, in the form of short knotty blocks.

It is used almost in the same way as ordinary fustic (*morus tinctoria*), though the decoctions of these two coloured woods present remarkably different reactions.

M. Chevreul, who has been almost alone in his chemical researches on fustic, found in it—1. A yellow colouring matter, presenting itself when pure in the form of small crystalline needles, and which he called fissetine, or fisetie acid; 2. A red substance, of which he is unable to decide whether it pre-exists in fustic, or whether it is only the result of an alteration of the fissetine.

By treating solid extract of fustic (obtained by evaporating its aqueous decoction) by concentrated alcohol,

there finally remains a residue, which dissolves with a red brown colour in water. MM. Bolley and Mylius have not yet examined this residue, which contains the red colouring matter.

The alcoholic solution furnishes, after concentration by the addition of water, a yellow crystalline precipitate. This same precipitate may frequently be found at the bottom of vessels in which aqueous extract of fustic has been kept for some time.

By washing it in cold water, collecting on a filter, pressing, and dissolving it in alcohol, then precipitating by water, and repeating this operation, it may easily be seen that the yellow crystalline substance thus obtained, and which precipitates acetate of lead of an orange red colour, is really quercetine.

### TECHNICAL CHEMISTRY.

*Results of the Experiments on the Carburation of Coal Gas, by H. LETHEBY, M.B., M.A., Ph.D., &c., Medical Officer of Health and Gas Analyst for the City of London.*

THE experiments made, during the last two years, on the carburation of gas at the street lamps, have developed a number of facts that should be placed on record, for these facts are not merely of scientific interest, they are also of practical value.

A common notion prevails that the use of the carburettors in the public lamps has not been successful. I have, therefore, made it my business to ascertain whether this notion is founded on fact, and if so, whether the failure is due to an imperfection in the principle of the process, or to the manner in which it has been applied.

On the first of these heads it is necessary only to say that, while, on the one hand, it cannot be denied that the use of the carburettors has not given public satisfaction, so, on the other, it must be admitted that, although the process has not been fairly applied, its want of success is by no means so great as is generally supposed.

The principle involved in the process is, beyond all question, a correct principle, in so far as it relates in its application to the very inferior gas of London; but the success of the process is dependent on certain conditions which have not always been fulfilled. It has been ascertained, in fact, that the results of the process are affected by a great number of circumstances, many of which have been either disregarded, or have been placed beyond our control. These circumstances are—the quality of the naphtha, the time of the experiment, the temperature of the apparatus, the form of the carburettor, the quality of the gas, and the rate at which it traverses the instrument. All these circumstances have received attention, and the following are the results of it:—

1. *As Regards the Quality of the Naphtha.*—This has a very marked influence on the illuminating power of the naphthalised gas. In point of fact, I have ascertained, by experiment, not only that the different naphthas of commerce furnish different proportions of vapour to the gas, according to their different degrees of volatility, but, also, that those vapours are endowed with very different degrees of photogenic power. A single grain, for instance, of some of the hydrocarbons to each cubic foot of common gas will raise its illuminating power to the extent of only about 1.69 per cent.; whereas a grain of other hydrocarbons will raise it nearly 9 per cent. This is illus-

\* *Polyt. Notizbl.* p. 350. 64.

† *Schweiz, Polyt. Zeitschr.*, ix. 22. 64.



trated by the following table, where only a few of very many experiments are recorded:—

Table of the specific gravity, boiling point, volatility, and illuminating power of the various Naphthas used in a common street carburettor, with a batswing burner consuming three feet of Gas per hour.

Specific gravity, water being 1000.	Boiling point (Centigrade). (deg.)	Amount per cent. yielded by distillation.		Average quantity taken up by each foot of gas. (grains.)	Percentage increase of illuminating power.	
		Up to 130° Cent. (grains.)	From 130° to 150° Cent. (grains.)		Total.	For each grain of Naphtha per cubic foot.
698	63	86	14	20.1	33.9	1.69
676	40	98	2	34.4	62.1	1.80
869	102	76	22	12.1	40.8	3.37
827	115	56	40	6.5	21.7	3.43
808	117	27	53	6.1	21.0	3.60
852	128	4	51	3.8	14.2	3.72
869	107	75	19	9.2	34.9	3.79
869	103	83	14	11.8	46.8	3.96
816	119	15	45	3.4	14.4	4.23
856	114	23	49	4.4	18.9	4.29
814	105	60	34	7.0	33.5	4.78
865	124	9	34	3.3	15.8	4.79
845	90	92	8	12.0	65.3	5.44
874	119	45	37	4.8	26.7	5.56
879	93	92	8	9.5	53.2	5.60
870	129	5	44	2.8	15.7	5.61
862	121	10	45	3.3	20.4	6.16
848	97	77	15	10.2	68.4	6.70
861	117	24	29	2.3	18.8	8.17
875	110	75	20	6.9	60.8	8.81

It would seem from this, that a naphtha with a low specific gravity, and a low boiling point, is not well suited for the carburation of gas; for, although it yields a large quantity of vapour to the gas, the photogenic value of it is but small. This is the kind of naphtha obtained from the petroleums and shales of commerce, and it has not unfrequently been found in the naphthas supplied to the public lamps. On the other hand, the naphthas obtained from coal tar are much richer in carbon, and are, therefore, better suited for the carburation of gas. But the more volatile of these naphthas are so largely used in the manufacture of red and purple dyes, that it is difficult to obtain them, at a reasonable price, for the street carburettors. I have, therefore, been compelled to specify a quality of naphtha which is not well fitted for the manufacture of dyes; but this, also, is of rather low volatility, and is, therefore, not so good for the carburation of gas as it ought to be. The terms of the specification are, "that the naphtha shall be colourless; of a specific gravity of about 870; of a boiling point not higher than 110° C. (230° Fahr.); and yielding, on distillation, at least 70 per cent. of volatile naphtha, between the boiling point and 130° C. (266° Fahr.); and 20 per cent. between 130° and 150° C. (266° and 300° Fahr.)." This naphtha (the last in the table) furnishes about 7 gr. of hydrocarbon vapour to each cubic foot of gas, at ordinary temperatures, and it raises the illuminating power of the gas about 60 per cent.; in other words, it increases the light of a three-foot batswing burner from about seven candles to eleven, and thus makes three feet of gas of the same value as 4.8. If it were possible to obtain, at a reasonable price, a coal naphtha of a little higher volatility at ordinary temperatures—as, for example, a naphtha yielding about ten grains of hydrocarbon to each cubic foot of gas,—the

illuminating power of the gas would be increased about 68 per cent. A gallon of this naphtha will weigh nearly 60,000 grains, and it would be sufficient to naphthalise 6000 cubic feet of gas—making them equal to about 10,000 feet of unnaphthalised gas. Such a naphtha, even at 6s. per gallon, would be equal to just three times its money worth of gas; for a gallon of the naphtha, costing 6s., would give the light of 4000 cubic feet of gas, costing 18s. The only difficulty, at present, in the realisation of this object is, in the uncertain composition of the naphthas of commerce; but this difficulty would soon be overcome if a steady demand for such a naphtha existed. Even as it is, it may be said that the common coal naphthas of commerce increase the illuminating power of the London gas to the extent of about 4.5 per cent. for every grain of naphtha taken up by a cubic foot of gas. These naphthas are obtained at a maximum price of 4s. per gallon, and a gallon will double the illuminating power of rather more than 2600 cubic feet of gas; in other words, we have 4s. worth of naphtha doing the work of about 12s. worth of gas. These are the unquestionable results, not merely of laboratory investigations, but also of carefully conducted experiments at the public lamps in Moorgate Street.

**2. As Regards the Time, or Duration, of the Experiment.**—As all the naphthas of commerce are mixtures of various hydrocarbons of different degrees of volatility, it happens that the most volatile constituents of the naphthas are given up, very freely, to the gas at the commencement of the experiment, and the less volatile, with more difficulty, at the end. In consequence of this, there is always a large increase of illuminating power when the carburettor is first charged with naphtha, and a marked diminution of it at last. This irregularity has not, hitherto, been compensated for by a regulated supply of gas; and, therefore, it has happened, that when a naphtha yielding, at first, as much as twenty-three grains of hydrocarbon per cubic foot of gas has been used, the illuminating power has been doubled; but, after a time, from the diminished volatility of the naphtha, the power has gradually fallen to less than 25 per cent. Numerous experiments have been made to determine the influence of this circumstance on the value of the process, and the following table is given in illustration of it:—

Table showing the differences in the volatility of the Naphtha, and the illuminating power of the Gas, at different periods of the experiments.\*

Quantity of gas passed. (cubic feet.)	Quantity of naphtha taken up per foot of gas. (grains.)	Illuminating power, in standard sperm candles.		
		Not carburetted.	Carburetted.	Increase per cent.
80	23.2	6.78	13.68	101.7
152	21.6	7.42	14.30	92.8
136	17.6	7.45	13.24	75.1
232	15.6	7.25	12.10	67.0
198	11.6	6.80	10.19	50.0
249	11.5	7.04	10.44	48.3
285	11.5	7.17	10.81	50.1
330	7.4	7.62	10.04	31.8
451	7.3	7.18	9.60	33.7
2113	12.1	7.21	11.60	60.1

\* This experiment was made with a street carburettor of the form designed by me, and with 26,000 grains, or nearly four pints, of common naphtha, having a density of 869, and a boiling point of 103° C., and yielding 82.7 per cent. of distilled product from its boiling point to 130° C., and 14.3 per cent. from 130° to 150° C. The experiment was continued for thirty days and nights, and the gas was continually burning from a three-foot batswing burner, the temperature of the room being 22° C. (72° F.)



**3. The Influence of Temperature on the Carburation of the Gas.**—In warm weather the volatility of the naphtha is increased, and, therefore, a larger amount of hydro-carbon vapour is given to the gas. A few experiments have been made, at different times of the year, on the street carburettors, with the view of ascertaining the extent of this influence within common ranges of temperature. The following are the results:—

*Table showing the volatility of the Naphtha, and percentage amounts of increase of illuminating power, according to temperature, at different seasons of the year.*

Season.	Temperature, Fahrenheit.	Quantity of naphtha per cubic foot of gas (grains).	Per centage increase of illuminating power.
Spring . . .	41°	5.25	23.6
Summer . . .	72°	12.09	54.4
Autumn . . .	62°	10.77	48.5
Winter . . .	37°	4.94	22.2

These results show that it is of great importance to keep the carburettors at as uniform a temperature as possible; and it is with this view that the Carburetting Company have placed the apparatus within the lamps, thinking that, in such a situation, a common and uniform temperature of about 60° would be maintained. There is, however, a better situation at the top of the lamp, where the temperature, at the time of carburation, would be very uniform at all seasons of the year, and where the apparatus would be entirely out of sight.

**4. As Regards the Form of the Apparatus.**—Experiment has proved that the form of the apparatus has a very marked influence on the carburation of the gas; for when the instrument is so constructed that the gas merely passes into the chamber containing the naphtha, without sweeping over the surface of the liquid, a very small proportion of the volatile hydro-carbon is taken up. On the contrary, when the gas is brought into contact with a large surface of naphtha, it becomes highly charged with the vapour, and acquires a high illuminating power. In the course of the experiments which have been made for the purpose of estimating the value of this influence, four kinds of carburettors have been used, namely:—

1. A simple chamber, containing naphtha, with an inlet and exit pipe for the gas at the apex of the apparatus.

2. The carburettor supplied by the Carburing Company, which is contrived to make the gas flow once over the surface of naphtha before it leaves the chamber.

3. A carburettor contrived by me, which has a series of septa for making the gas pass many times over the naphtha before it leaves the apparatus.

4. A carburettor of M. Mongruel, and also one of M. Nordhoff, both of which contain septa of cotton threads, saturated with naphtha, through which the gas must pass, and so become highly charged with vapour before it leaves the chamber.

In operating with each of these carburettors, under the same circumstances, and with the same naphtha—namely, that supplied according to the contract, it was found, that while the first form of apparatus gave only 3.2 grains of naphtha per cubic foot of gas, the second gave 6.0 grains, the third 12.1 grains, and the fourth from 22 to 23 grains. It is manifest, therefore, that to secure a uniform supply of hydrocarbon vapour, it is necessary to bring the gas into contact with a large surface of naphtha.

**5. The Quality of the Gas Affects the Carburation.**—When gas is already charged with a large pro-

portion of the richer hydrocarbons, it manifests no disposition to take up the vapour of naphtha—on the contrary, if it be a cannel gas of very high illuminating power, the naphtha will deprive it, to a certain extent of its hydrocarbons, and so render it weaker,—the process, therefore, is only applicable to such a poor gas as that which is supplied to the City; and, even in the case of this gas, it has been noticed that when a dose of naphtha has been already given to it, it does not show the same tendency to absorb the vapour as it did before.

**6. The Carburation of the Gas is Affected by the Rate at which it Traverses the Apparatus.**—

This might be easily perceived from the circumstance that the longer and more completely the gas is brought into contact with the naphtha, the more fully it becomes charged with its vapour. Experiment has shown that when in the same carburettor the gas is burnt at the rate of 3 feet per hour, and the light is increased to the extent of 41 per cent., it will be only increased to 34 per cent. if it is burnt at the rate of  $3\frac{1}{2}$  feet per hour; but this difficulty is easily overcome by increasing the surface of naphtha.

In conclusion, therefore, it may be said, that although the success of the carburetting process is evidently dependent on many conditions, yet, as all these conditions are under control, there is no reason that they should not be at all times fulfilled, and the success of the process secured. One thing, it will be observed, is beyond all question, and that is, that every grain of common coal naphtha given to a cubic foot of gas increases its illuminating power about 4.5 per cent. (a good naphtha will increase it about 8 per cent.); and this grain of naphtha costs only about one-third of its equivalent in London gas.

#### *Acetone in the Manufacture of Varnish,\* by M. le Dr. WIEDERHOLD.*

ACCORDING to M. Wiederhold, acetone rendered anhydrous by rectification over chloride of calcium readily dissolves cold copal which has been previously heated to the point of fusion. Only 2.8 of acetone are required for 1 of copal, and a copal varnish is thus obtained, which dries almost instantaneously, leaving a hard, brilliant, and durable coating. A more concentrated and almost syrupy solution is obtained, without separating any copal, by expelling part of the acetone by distillation.

Evaporated to dryness, the remaining copal is more soluble in acetone than when in its original state. The solubility of gum lac in acetone varies according to the species of the gum; 1 part of artificially bleached gum lac required only 1.5 of acetone to form a thick solution like syrup, another, a coloured specimen of gum lac, was almost insoluble, and a third required 3.5 times its weight of acetone to dissolve it.

Acetone dissolves with especial facility, and in considerable quantities mastic and sandarach; dammar, yellow amber, and india-rubber are, on the contrary, almost insoluble. The solution of acetone and mastic produces a very beautiful and brilliant varnish. M. Wiederhold is of opinion that acetone might be employed for the restoration of oil paintings deteriorated by the alteration of the varnish, which often becomes opaque from the effect of a molecular modification, and which, from a vitreous and transparent state, becomes crystalline or pulverulent. By carefully applying acetone the opaque varnish may be momentarily dissolved, and will then redispense itself, but in a vitreous state.

\* Dingler Polyt. Journ., clxxii., 460. 64.



## PROCEEDINGS OF SOCIETIES.

### ACADEMY OF SCIENCES.

March 6, 1865.

M. CHEVREUL read a second section of his historical "Note on the Various Opinions which have been held on the Composition of the Atmosphere." In this section he reviewed the opinions of Stahl and others. It would be curious to know what has stimulated the learned academician to treat or bore his brethren with this *rechauffé* of papers he published some years ago.

M. Faye communicated a letter he had received from Father Secchi, "On the Constitution of the Sun," and made some additional remarks of his own, in which he quoted the experiments of Mr. Huggins on the spectra of the nebulae in support of his opinions on the physical constitution of the sun. We shall give an outline of these in connection with the last communication of Mr. Huggins to the Astronomical Society on the spectrum of the great Nebula in Orion.

A memoir by Vice-Admiral Coupvent de Bois was read "On the Horary Variations of the Barometer." It has already been shown that on continents the variations of the barometer go on diminishing from the equator towards the poles. The Admiral shows from observations made during a long voyage that the same variations were remarked at sea until he reached the latitude 60° south, where the horary variations became almost insensible.

M. Nicklés presented a memoir "On the Existence of Bichlorides of Manganese, and similar Iodine and Bromine Compounds." By treating peroxide of manganese with hydrochloric acid, we obtain chlorine and chloride of manganese, and the books explain that half the chlorine is given off because a bichloride of manganese corresponding to the binoxide does not exist. The author, however, shows that such a compound may be formed. Having seen before that water decomposes certain perchlorides, perbromides, &c., while ether renders them stable, he made experiments in this direction, and discovered that a perchloride of manganese might be formed in two ways, either by passing a current of dry chlorine upon the protochloride held in suspension in ether or alcohol, or by acting on the peroxide by hydrochloric acid in the presence of these liquids. The latter process gave the best results. It succeeds in any case; but it is well to keep the vessel containing the oxide and ether well cooled. The product is of a green colour, and is very unstable, and quickly gives off chlorhydric gas. Though soluble in all proportions in ether, it is insoluble in sulphide of carbon. Phosphorus decolorises the solution, forming protochloride of manganese, as also do iron filings, and zinc, and antimony in powder. Perbromide and periodide of manganese may be obtained in a similar way. They are all deep-green coloured compounds. So also are the compounds given by  $Mn_2O_3$  with hydrochloric, hydrobromic, or hydriodic acid gas in ether or anhydrous alcohol. The ether compounds appear more stable than those obtained with alcohol. The author foresees the possibility of procuring many haloid compounds not yet obtainable, and dreams, he says, of obtaining chloro-arsenic acid,  $AsCl_5$ , which defeated all the attempts of Rose.

M. Deville communicated a letter of M. Berthelot "On the Calorific Phenomena which Accompany the Formation of Organic Compounds." This letter is the first of a series promised by the author, and seem to us of sufficient importance to demand full translation. In his present letter the author deals with the carbides of hydrogen and alcohol.

M. Renault communicated "A New Method of Quantitative Analysis Applicable to Alloys." This is a physical experiment in which the amounts of metals are calculated from the quantity of electricity furnished by their solution in acids. The idea is very ingenious; but the author confesses that the results are never so accurate as those

daily obtained by the ordinary methods, so we may pass it over.

M. Elie de Beaumont presented a note by Signor Sismonda "On a Specimen of Gneiss bearing the Imprint of an *Equisetum*." The author believes in the metamorphic origin of Alpine gneiss, and draws important consequences as to the age of plants. He thinks that in special cases, and notwithstanding geological catastrophes, the existence of the plants in some localities under climatic conditions was prolonged beyond the carboniferous period. Fancy the Alps an island washed by the gulf-stream, and we have all the conditions necessary. This discovery of Signor Sismonda was referred to by Professor Ramsay in his lecture on the Eozoon at the Royal Institution last Friday.

## NOTICES OF BOOKS.

*Report on the Air of Mines and Confined Places.* By ANGUS SMITH, Ph.D., F.R.S. Part of the Appendix to the Royal Mines Commission. 1864.

THE Government of a wealthy country is specially interested in promoting the health of the producers of wealth. The individual employer who knows of nothing but the "cash nexus" between himself and his *employés* is simply anxious to get his work done. If some men die he knows that others come for their places, and that is enough for him. A Government must needs take a wider view of the matter. It sees in shortened and diseased lives a serious diminution of national wealth which springs from labour alone; and beyond this, in the same spirit as it provides for the defence of a citizen from personal assaults, it feels (or should feel) it a duty to defend him from more insidious and dangerous attacks on his life. With this view various laws have been passed for the protection of classes who are placed in circumstances under which they cannot protect themselves. We need not instance these laws; but we may say that miners have, to some extent, shared the protection they afford.

The ventilation of mines is a matter which has received much attention; but hitherto the great object of care has been to prevent the accumulation of fire-damp. The air which the miner breathes, and which, in process of time, may be as fatal to him as an explosion of fire-damp, has been but little thought of. Considerable importance was attached to this subject by some of the members of the last Royal Commission; and Dr. Angus Smith was instructed to make investigations on the air of mines. We have the results of these in this Appendix to the Report of the Commission, and we propose to devote a few pages to a *resumé* of them.

Before any conclusion could be arrived at as to what was impure air, it was necessary to decide what normal air was. Fortunately a great number of—we might say all—the most eminent chemists have given us few or many analyses of air. It engaged the attention of all the earlier analysts, and, considering the disadvantages under which they worked, their results exhibit sufficient uniformity. Priestly, in his first experiments, found the difference of oxygen sometimes to amount to as much as 6 per cent.; Scheele's results with the same gas differed to the extent of 10 per cent.; others were even wider in their discrepancies. It was Cavendish who first arrived at anything like exact results, and showed from 500 examinations of air that it had a nearly constant composition, and that the mean percentage of oxygen was 20.883. Many thousands of analyses of air taken at the surface of the earth have been made by various methods since Cavendish died; but if all with any pretensions to accuracy were summed up, and the mean result calculated, it would only differ from Cavendish's number in a decimal place.

We have not space to quote more than the results of Regnault and Bunsen upon which Dr. Smith sets the



greatest value. Regnault analysed the air of Paris and that from various parts of the world, and found an average of 20.949 per cent. of oxygen. Bunsen made a series of examinations of the air at Heidelberg, and there found a mean of 20.924 of oxygen. Dr. Smith adopts these results, and assumes what we may call normal air to contain 20.9 of oxygen.

Carbonic acid may be regarded as universally present in the atmosphere, and therefore it was necessary to decide what should be considered the normal proportion of this gas. Saussure occupied a good deal of his life in the examination of the atmosphere, and paid special attention to the determination of carbonic acid. His results exhibit variations of no great limits, the air round Geneva giving 0.035 to 0.054. But one unexpected result of his experiments was the discovery that the air on mountains contains more carbonic acid than that on the plains. The results of Brunner, Boussingault, Berger, and Frankland indicate a diminution of oxygen on the mountains,\* and the increase of carbonic acid there is a corroboration.

Saussure accounts for the diminution of carbonic acid on the plains by the rain which washes the air, and vegetation, which consumes the acid. Dr. Frankland found 0.111 per cent. of carbonic acid in air taken at the Grand Malets (there was less at the summit of Mont Blanc); and the Schlaginweits assert an increase of the gas up to a height of 11,000 feet.

Dr. Smith accounts for this increase of carbonic acid on the mountains on the supposition that organic matter is in the higher regions more completely oxidated, which, at the same time, accounts for the diminution of oxygen. We have then, he says, two distinct varieties of air: one on the mountains, in which there is more carbonic acid and less oxygen, but no organic matter; and another on the plains, in which we have less carbonic acid, more oxygen, and more or less organic matter. With the last of these we cannot at present occupy ourselves; but so far as carbonic acid is concerned we may note that Dr. Smith considers the normal proportion of this gas in a wholesome atmosphere to be 0.04 per cent. Normal air, then, we may assume to be composed of—

Oxygen	.	.	.	.	20.96
Carbonic acid	.	.	.	.	0.04
Nitrogen	.	.	.	.	79.00
					100.00

With these proportions before us we may proceed to the air of impure places.

(To be continued.)

*Chemisches Central Blatt.* Nos. 5, 6, 7, 1864.

We have in these papers, as usual, abstracts of the papers published in other journals, but no original articles. Most of these papers we have already noticed, but we find several short abstracts which we shall transfer to our pages.

## NOTICES OF PATENTS.

1519. *Grinding and Polishing Glass.* J. H. JOHNSON, Lincoln's Inn Fields, London. A communication. Dated June 18, 1864.

In the grinding and polishing of convex and concave glass surfaces the inventor claims the adoption of the method commonly employed in the preparation of plane surfaces—viz., by rubbing the two surfaces together with emery, putty powder, or other grinding or polishing material placed between. In this way it is proposed to grind convex and concave surfaces simultaneously by mutual attrition, and it is only necessary that the curves should be suited to each other.

\* Dr. Miller found only 20.88 per cent. of oxygen in air taken in a balloon ascent at 18,000 feet.

1520. *Manufacture of Looking-glasses, Mirrors, &c.* J. H. JOHNSON, Lincoln's Inn Fields, London. A communication. Dated June 18, 1864.

As a substitute for silver, or the amalgam of tin, commonly used as the reflecting surface in looking-glasses and mirrors, the inventor proposes to employ foil or polished surfaces of platinum.

There was an effort made many years ago to introduce incorrodible platinum reflectors, made by coating the inner or concave surfaces of china or earthenware plates with the reduced metal applied as an enamel.

1525. *Obtaining Colouring Matters.* R. SMITH and C. SIEBERG, Glasgow. Dated June 20, 1864.

For the production of violet dyes the inventors treat rosaniline, or a salt of that base, with hydriodic acid and alcohol, or methylated spirit. They prefer to use these ingredients in the following proportions—viz.: 75 parts of rosaniline, and 160 parts each of methylated alcohol and concentrated hydriodic acid of the boiling point 250° F. This last-named reagent they propose to make by the action of hydrosulphuric acid upon iodine suspended in water, and afterwards concentrate the product by driving off by heat the large excess of water. The operation of heating the mixture aforesaid is conducted at the temperature of 250°—270° Fahr. in a closed iron vessel lined with lead, and maintained for about four hours, or until the desired tint of colour is produced.

1529. *Improvements in the Means of Preventing the Formation of, and in the Removal of, Incrustations or Deposits from Steam-engine Boilers.* J. H. BEATTIE, Dowgate Hill, London. A communication. Dated June 20, 1864.

THIS boiler composition, or anti-incrustation powder, consists of chloride of ammonium in admixture with mahogany sawdust and raw sugar. For its preparation the patentee directs to take by weight

Hydrochloric acid	.	.	25 parts.
Liquor ammonia	.	.	25 "
Sugar	.	.	33 "
Mahogany dust	.	.	17 "

It will be perceived that the patentee prefers to mix together hydrochloric acid and ammonia for the purpose of obtaining sal-ammoniac, and so far as the employment of this agent is recommended the process resolves itself into a modification of that proposed many years ago by Ritterbandt. By the action of sal-ammoniac upon the carbonate of lime in the water, chloride of calcium is formed with elimination of carbonate of ammonia vapour with the steam.

## GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

2704. W. Smith, Salisbury Street, Strand, "Improvements in tanning leather, and in the apparatus to be employed for that purpose." A communication from A. Jullien, Nantes, France. —Petition recorded Nov. 2, 1864.

2719. C. Garton, Bristol, and Thomas Hill, Southampton, "Improvements in brewing, fermenting, racking, and bottling beer, ale, and wine." —Nov. 3, 1864.

27. N. Thompson, Abbey Gardens, St. John's Wood, "Improvements in stoppers for bottles, jars, vessels, and tubes, also for ordnance and firearms." —Jan. 4, 1865.

249. V. Burg, Paris, "Improvements in filtering apparatuses." —Jan. 28, 1865.

344. W. Sim, Glasgow, N.B., "An improved method of, and improvements in apparatus for, extracting gases from mineral oils, and employing the same for illuminating purposes." —Feb. 7, 1865.



398. P. A. le Comte de Fontaine Moreau, Paris, "Certain improvements in the manufacture of caoutchouc." A communication from L. D. Innocent and F. Perroucel, Montrouge, France.—Feb. 11, 1865.

443. E. B. Wilson, Glasgow, N.B., "Improvements in furnaces."—Feb. 16, 1865.

464. J. J. Chidley, Glaskin Street, Hackney, "An improved method of stopping bottles."

469. J. Graham, Manchester Road, Warrington, Lancashire, "Improvements in treating products obtained when coating iron with zinc."

473. J. G. N. Alleyne, Alfreton, Derbyshire, "Improvements in puddling furnaces, and in apparatus connected therewith."—Feb. 18, 1865.

481. R. Willison, Alloa, N.B., "Improvements in mashing machines, and in apparatus connected therewith."—Feb. 21, 1865.

#### NOTICES TO PROCEED.

2706. J. Forster, Rathgan, and H. Draper, Rathmines, Ireland, "Improvements in the preparation or manufacture of paper, in order to prevent the extraction or alteration of writings thereon without detection."—Petition recorded Nov. 2, 1864.

2723. F. L. Beauwens, Walworth, Surrey, "Improvements in cooking food."—Nov. 4, 1864.

456. J. O. Christian, F.C.S., Manchester, and J. and H. Charlton, Strangeways, Lancashire, "Certain improvements in the manufacture of magnesium and its compounds."—Feb. 17, 1865.

### CORRESPONDENCE.

#### Continental Science.

PARIS, March 14.

You said some time ago that an original idea might occur to two men at the same time. I think we have an illustration of this fact. M. Duchemin has just published an account of a modified Bunsen's battery, in which he uses the same liquid, a solution of perchloride of iron, that your correspondent, Mr. Reynolds, suggested some time ago in the CHEMICAL NEWS. M. Duchemin has gone a step further, and substituted a solution of chloride of sodium for sulphuric acid with the zinc, with the loss, of course, of some force, but still with enough to excite a small Rhumkorff with one cell; and by surrounding the zinc with water alone he gets a constant current, useful for telegraphic purposes.

M. Alexandre is a large maker of steel pens. He has establishments at Paris, at Brussels, and at Birmingham, and he has occupied himself a good many years, he says, in perfecting metallic pens. These having arrived at a state of perfection, M. Alexandre finds that there is something wrong with all the inks. They destroy the paper and spoil the pens, and so bring a perfect article into unmerited disrepute. Therefore M. Alexandre offers a prize of 1500 francs for a perfected ink. He has, indeed, a direct interest in the rapid destruction of steel pens, but he has a soul above pens, and rather than a perfected manufacture should be reproached with failures not its own, he offers this prize for an uncorroding ink, though the result may be that one steel pen will last a lifetime, and ink-makers may flourish while pen-makers decay. M. Alexandre is very disinterested, and I hope some ingenious chemist will be able to suit him with an ink. The Society for the Encouragement of Industry will award the prize six months after its official announcement, which has not yet been made.

A public laboratory was opened at Strasburg on the 1st of January, in which work is done upon much the same terms as under your Adulteration Act. The prefect of the department has fixed the tariff of charges, which are as under:—For a water analysis, 10 to 15 francs; for a

quantitative analysis of manures and trade products, 6 francs. The work is done at the laboratory of the Upper School of Pharmacy, and I should think the charges would convince the students of the inadvisability of pursuing analytical chemistry as a means of getting a livelihood—at all events, in the Department of the Bas-Rhin.

Soot, it is found, does not cure pébrine, the name given to the disease which has threatened to exterminate silkworms in France, and M. Onesti will not, therefore, get the trifle of 500,000 francs which he modestly expected for his notable and original suggestion.

A recent traveller in Abyssinia, Mgr. Van den Deck, has sent to the Belgian Royal Society an interesting account of the tape-worm which so commonly afflicts the inhabitants of that country. I said afflicts; but the expression must be qualified, for it seems that the possession of worm is by some considered a means of increasing their enjoyments. They take small doses of kouso only to get rid of the body, when the worm gets of an inconvenient size; but they are anxious to retain the head, for they are terrible gluttons, and having a tenia enables them to eat so much more. Here is a hint for aldermen and gourmands in general. The tenia common in Abyssinia is *T. mediocancellata*.

There is probably no reader of the CHEMICAL NEWS who is not familiar with the test for the detection of chicory in coffee just published by M. Coulier; and I only quote it for the sake of the explanation he gives. Coffee, we all know, swims on water, while chicory sinks. The reason for this, says M. Coulier, is, that in the roasting of coffee the berry becomes distended, so to say, with carbonic acid, while in the roasting of chicory no gas is disengaged.

M. Thibierge, of Versailles, suggests a method of exhibiting diagrams of apparatus, &c., which may at all events save lecturers the expense of the large pictures now commonly in use. He makes a small sketch of the apparatus on a plate of glass, and with a large lantern throws a magnified image on a screen. The lantern he illuminates by an ordinary gas burner with twenty-four holes, and with two silvered reflectors finds the light sufficient even to give a well-defined image of the electrolysis of water.

#### Destruction of Parasites.

To the Editor of the CHEMICAL NEWS.

SIR,—As I have been a severe loser in consequence of a communication to your journal of January 20, I trust you will do me the favour of inserting the following case:

A large and valuable retriever, aged four years, with traces of mange about him, was treated as recommended by Mr. Israel Swindells, of Wigan; with the exception that the solution was half the strength mentioned by that gentleman. This was on Tuesday, middle day, and on my visiting him eight hours subsequently I found him dejected in spirits and unwilling to eat. Severe purging and vomiting set in, and continued until Thursday, the excretions being markedly of a green and unnatural colour. He was immediately washed, the abdomen and neighbourhood of the larger joints being found to be quite raw. Stimulants and warmth were freely applied, but the animal gradually sank, and died early Monday, never seemingly having attempted to rally. After death the lips and inside of the mouth were found to be extensively ulcerated. Apologising for encroaching on your valuable space.

I am, &c. ONE WHO LOVED HIS DOG.  
South Kensington, March 8.

### MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday, March 21, at 3 o'clock, Professor Masson, "On Recent British Philosophy." Thursday, March 23, at 3 o'clock, Professor Masson, "On Recent British Philosophy." Friday,



March 24, at 8 o'clock, Professor Westmacott, "How Works of Art should be Looked at." Saturday, March 25, at 3 o'clock, Professor Marshall, "On the Nervous System."

**The Royal Society's Soiree.**—On Saturday evening last the President gave his first *soirée* during the present year, at Burlington House, which was honoured by the presence of His Royal Highness the Prince of Wales and a distinguished circle of visitors. The rooms of the Royal and Linnean Societies were those set apart for the reception, and a variety of interesting objects were exhibited, particularly we noticed the following:—A series of original drawings by Albert Dürer, Claude Lorraine, and other old masters, from the Queen's collection. Paintings illustrative of Explorations in South-West Africa, by Mr. Baines, and model of the Victoria Falls, Zambesi River. Messrs. Marion and Co.'s photographs of Turner's pictures. Ancient marble statuette of Venus, from Crete. A magnificent series of Chinese enamels on copper and Japanese nature-castings in bronze were exhibited by Mr. Alfred Tylor. A large model of a 3000 ton, 800 horse power, steam yacht, now building for the Pacha of Egypt by Mr. Samuda, which it is expected will be the fastest vessel afloat. A very complete collection of Stone Implements recently found in Poitou, by Messrs. Evans and Christy, and another series of flint, bone, and horn implements from the Dordogne Caves, were exhibited by Messrs. Christy and Lartet; also, Mr. Brady's ancient flint and bronze implements from Denmark. A variety of natural history specimens and products from West Africa, Japan, &c., were shown by Dr. Welwitsch, Mr. S. W. Silver, and others. Among the electrical apparatus were Thomson's Electrometer, arranged for photographic registration, by Messrs. Elliott, Brothers; a large Electro-Chronograph, about to be used for the determination of longitude in the great trigonometrical survey of India, exhibited by Lieut.-Col. A. Strange, F.R.S.; Mr. Fleming Jenkin's new Unit of resistance; Gisborne's Ship Signals, by Silver and Co.; a working model of Froment's Electro-magnetic Engine, by Prof. Tyndall, who also showed his apparatus for experiments on invisible radiation. Microscopes were exhibited by Messrs. Smith and Beck, Powell and Lealand, Mr. Ladd, and Mr. J. Browning. The last-named gentleman showed a large prism in flint glass, measuring five inches by four, and a very beautifully executed hollow glass sphere, which is intended to be used in some experiments on the density of gases. The Herschel-Browning direct vision Spectroscope was likewise shown. The  $\frac{1}{10}$ th inch object-glass of Messrs. Powell and Lealand excited much attention. A pair of horns of *Bos antiquus*, discovered at Camberwell whilst digging for the main drainage, and a model of the Thames Embankment, were exhibited by the Metropolitan Board of Works. Besides the above, some fine specimens of wood carving, by Mr. W. H. Rogers; of electro-sculpture, by Mr. Durham; and the Wedgwood medallions of Dr. Sibson, and electrotypes of antique gems of Mr. J. Williams, were much admired.

**Spontaneous Disengagement of Free Iodine in a Mineral Water.**—On uncorking a bottle half full of the Heilbronn mineral water from the Adelheid spring, after it had been for several years in the bottle, a strong odour of iodine arose from it; the water turned starched paper blue, and consequently contained free iodine. The experiment was repeated with two other bottles of this water; with one it succeeded, with the other the paper was made blue only by immersion in the air of the bottle.—*Wittstein, Chem. Centralbl.*, p. 1069. 64.

**Test for Tartar Emetic.**—Claus points out that perchloride of iron causes a yellow colouration in a strong solution of tartar emetic; but in a dilute solution occasions a yellow precipitate, which seems to consist of a mixture of basic chlorides of antimony and iron and some tartar emetic.—*Chem. Central Blatt*,

**Obituary.**—We regret having occasion to announce the death of R. L. Chance, Esq., late of Summerfield House, near Birmingham, which occurred on the 7th inst., whilst visiting friends at Gravesend. Mr. Chance devoted himself during a long life to the improvement of glass, and has in this way done much to aid the researches of astronomers, microscopists, and physicists. The English opticians and artists in many branches are mainly indebted to him for the manufacture and supply of superior qualities both of white and coloured glass. He died in his eighty-third year, and his removal will cast a gloom over the forthcoming meeting of the British Association.

**Colouring Matter of Ripe Olives.**—Landerer finds that the colouring matter of ripe olives can be extracted by simply boiling with water, which gives a purple decoction, made red by acids and green by alkalies. The decoction dyes cotton and wool shades from a beautiful violet to crimson, and the author believes that the colour may be found useful for technical purposes.—*Chem. Central Blatt*.

**The Preparation of Hypochlorite of Soda.**—By substituting a solution of bicarbonate of soda for one of carbonate in the preparation of hypochlorite of soda, a precipitate of carbonate of lime is obtained in the form of a crystalline powder, depositing itself very easily, whilst, when a solution of ordinary carbonate of soda is employed, a kind of magma forms, which it is difficult to separate from the liquid by decantation. A small excess of bicarbonate of soda in the liquid is, as has been proved by experiment, very advantageous in some respects. With hypochlorite of soda thus prepared hardly a minute is required to bleach any kind of engraving or printing without in the least degree damaging the paper, especially if it be immediately afterwards plunged for a few seconds in water in which a little acid sulphate of soda has been dissolved.—*Journal de Pharmacie et de Chimie*, I. 143. 65.

**Rapid Absorption of Crystalloid Substances.**—Dr. Bence Jones has communicated instances of the extraordinarily rapid passage of some substances into the vascular and non-vascular tissues of the body. Lithium administered to a guinea pig eight hours before death was found in the crystalline lens. In another pig killed two hours and a-half after the administration, the presence of lithium in the cartilage of the hip was distinctly shown. In another animal, killed after an hour, it was shown faintly in the hip and knee, but in the aqueous humour of the eye very distinctly. It was also found in the crystalline lens and joint cartilages of human subjects who took lithia within a very few hours of death.

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

*Cavendish.*—We were not at the meeting, but we have applied to the Secretary for a copy of the Report, which has not yet been forwarded.

*θ.*—Either Heidelberg or Berlin. Write to the Professors for information.

*Received.*—E. Divers, M.B.; shall be published next week. Jno. Horsley, Esq., next week; A Subscriber; Al-Chemicus.



## THE BILLS FOR REGULATING THE QUALIFICATIONS OF CHEMISTS AND DRUGGISTS.

THE rival Bills for regulating the qualifications of chemists and druggists are now before the House of Commons, and will probably be consigned to the ordeal of a Select Committee, before which the two societies must fight out their claims to be considered the exclusive representatives of their order. Which Bill, under these circumstances, is likely to become the law of the land it is impossible to conjecture. Probably neither will be passed this Session, or an enactment compounded of both may be successful, which, perhaps, is the best thing that could happen. Taken apart, each Bill contains salutary provisions, but, as a whole, neither can be regarded as entirely satisfactory. That of the United Society seems to provide cumbrous machinery for effecting simple objects, but in most other respects is reasonable. As, however, we have not yet the entire Bill before us, it is somewhat premature to express an opinion. The Bill of the Pharmaceutical Society cannot be regarded with so much satisfaction. One serious omission has been made at starting. Clause 1 would leave the retail trade in medicines and poisons completely without control, for it defines the business of a chemist as the "keeping of open shop for the compounding of the prescriptions of duly qualified medical men." Now, one would think that the Council of the Society must be aware that there are hundreds of chemists and druggists in the country who never dispense a prescription, or, at all events, who dispense so few as to make that department of their business of no consideration. A subsequent clause of the Bill, it is true, places restrictions on the use of the title "chemist and druggist;" but any man who wishes to open a shop and retail medicines has only to put show bottles in his window, and it is unnecessary for him to use any title at all if he found a difficulty in inventing an equivalent for the term chemist and druggist. The objections to this part of the Bill have been so well urged by one of the most intelligent supporters of the Society that it is unnecessary for us to dwell upon them further.

Another feature of the Bill which is certain to cause much opposition is the proposal to create two orders of pharmacutists. There is not the smallest necessity for this, and the proposal may be taken as an indication of great weakness or great selfishness on the part of the projectors of the measure. It is useless to argue the unfairness of men who have taken no interest in the Society being at once admitted to an equality with those who have devoted themselves to its interest for years. It must be so; and it is ever so in life, that men who have borne the burden and heat of the day find themselves at last with no greater reward than those who joined in a work at the eleventh hour. The Council had better, therefore, submit to it with the best grace they can, and consent to an amendment, at the risk of considerable changes in their own body. The reproach of being governed by a clique, which is continually brought against the Society, cannot, if deserved, be too quickly got rid of.

There is another point dwelt on by Sir John Shelley which is certain to command some support for the Bill of the United Society, and that is the proposal to regulate the sale and custody of poisons. We have urged before the absence of necessity for such regulations, and

we still hold the same views on the question. But unfortunately, the public is not with us, and general opinion demands a Poison Bill. It would better, then, to concede the matter; for if any inconveniences follow it will be the public who will suffer, and not the trade.

With such alterations and additions, we see no reason why a bill emanating from the Pharmaceutical Society should not become law, and the Society retain its place at the head of the trade. It deserves consideration for past services, and if at times we have occasion to denounce its pretensions as too high, and its aims as too exclusive, it is probably because the general body take but little interest in its management. For this reason we look to a large accession of members as likely to conduce to the interests of the Society itself, but we rest our objection to the two orders upon wider grounds. Each of the Societies includes some of the most intelligent and some of the most ignorant men in the trade. Why should not the Pharmaceutical Society be ready to avail itself of all the intelligence? and why should one fool enjoy privileges denied to another?

## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

### PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION II.—*New System of Atomic Weights.*

(Continued from page 122.)

GERHARDT'S system of atomic weights and notation never received the unanimous assent of chemists; and the discoveries made of late years seem to show that their author went too far in the reform which he inaugurated. It has been previously shown that he compared the protoxides to water, and had attributed to them the general formula  $R_2O$ , and that the equivalents of the metals were, in consequence, doubled. The density of mercury vapours seemed to furnish an argument in favour of such a reduction, but this argument is really of little value. The density of mercury vapour is evidently an anomaly, which we will endeavour to define and explain further on. The vapour-densities of chloride, bromide, and iodide of mercury assign to this element an atomic weight double that which is deduced from the anomalous density of its own vapour.

Moreover, the reduction of the atomic weights of most of the metals as proposed by Gerhardt would be contrary to the law of Dulong and Petit, to which the accurate researches of M. Regnault have latterly drawn attention.

M. Regnault remarked that as early as 1849\* the law of Dulong and Petit applied to all the elements with a few exceptions; and that to bring these under the influence of the same general law it was only necessary to double the equivalents of hydrogen, nitrogen, chlorine, bromine, iodine, phosphorus, arsenic, potassium, sodium, and silver; "for," said he, "the equivalents of these bodies, as given by their specific heats, are half those which have been fixed upon from chemical considerations." He justly said that the numbers so obtained no longer represented equivalents, and he proposed to term them *Thermic proportional numbers*.

\* *Annales de Chimie et de Physique*, 3rd series, xxvi., 261. See also *Premiers Elements de Chimie*, by M. Regnault. 1850, p. 544.







new atomic weights are double those which Gerhardt adopted, except those of the alkali metals, and silver, bismuth, and antimony.

It now remains to demonstrate that this system of atomic weights is in better harmony than any other; first, with the physical data which serve for the control and determination of atomic weights, and second, with the chemical facts.

The physical data made use of are:

1. The law of specific heats.
2. Isomorphism.
3. Vapour densities.

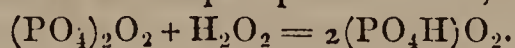
(To be continued.)

*On the Theory of Types in Chemistry,\**  
by T. STERRY HUNT, M.A., F.R.S.

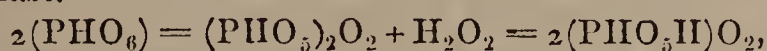
(Continued from page 125.)

Keeping this principle in mind, let us now examine the theory of the formation of acids. As we have just seen, I taught in 1848 that the monobasic, bibasic, and tribasic acids are derived respectively from one, two, and three molecules of water,  $H_2O_2$ . Mr. Wurtz seven years later (in 1855) put forth a similar view. He supposes a monatomic radical  $PO'_4$ , a diatomic radical  $P''O_3$ , and a triatomic radical  $PO'''_2$ , replacing respectively one, two, and three atoms of hydrogen in  $H_2O_2$ ,  $H_4O_4$ , and  $H_6O_6$ , thus  $(PO'_4H)O_2$ ,  $(P''O_3H_2)O_4$ , and  $(PO'''_2H_3)O_6$ . These radicals evidently correspond to  $PO_5$ , which has lost one, two, and three atoms of oxygen in reacting upon the hydrogen of the water type, and these acids may be accordingly represented as formed by the substitution of the residue  $PO_5-O$  for H, &c.

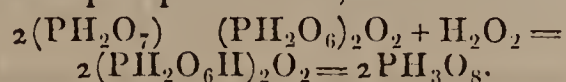
To this manner of representing the generation of polybasic acids we object that it encumbers the science with numerous hypothetical radicals, and that it moreover fails to show the actual successive generation of the series of acids in question. When phosphoric anhydrid,  $P_2O_{10} = (PO_4)_2O_2$ , is placed in contact with water it combines with one equivalent,  $H_2O_2$ . The union is followed by homogeneous differentiation, and two equivalents of metaphosphoric result,



Two equivalents of this acid with one of water at ordinary temperatures are slowly transformed into two of pyrophosphoric acid by a reaction precisely similar to the last.



and two equivalents of pyrophosphoric acid when heated with a third equivalent of water yield, in like manner, two of tribasic phosphoric acid,



Gerhardt long since maintained that we cannot distinguish between polybasic salts and what are called sub-salts, which are as truly neutral salts of a particular type. Thus the bibasic and tribasic phosphates are to be looked upon as sub-salts, which sustain the same relation to the monobasic phosphates that the basic nitrates bear to the neutral nitrates. He succeeded in preparing two crystalline subnitrates of lead and copper, having the formulas  $NO_5M_2O_2.HO$  (tribasic), and  $NO_5M_4O_4.H_3O_2$  (quadri or heptabasic), both of which retain their water of composition at  $392^\circ F$ . The com-

pounds of sulphuric acid are:—1st. The true monobasic sulphate  $S_2O_6MO$ , corresponding to the Nordhausen acid and the anhydrous bisulphates; 2nd. The ordinary neutral sulphates,  $S_2O_6M_2O_2$ ; 3rd. The so-called disulphates,  $S_2O_6M_4O_4$ , corresponding to the glacial acid density 1.780; 4th. The type  $S_2O_6M_6O_6$ , represented by turpeth mineral; and 5th. The so-called quadribasic sulphates,  $S_2O_6M_8O_8$ . The copper salt of this type, according to Gerhardt, retains, moreover,  $6HO$  at  $392^\circ F$ .—(Gerhardt on Salts, *Jour. de Pharmacie*, 1848, vol. xii.; *Am. Jour. Sci.*, vi. 337.)

Without counting the still more basic sulphates of zinc and copper described by Kane and Schindler, we have the following salts, which, in accordance with Wurtz's notation, correspond to the annexed radicals:—

- |                |                            |             |
|----------------|----------------------------|-------------|
| 1. Monobasic.  | $S_2HO_7 = S_2O_5$         | monatomic.  |
| 2. Bibasic     | $S_2H_2O_8 = S_2O_4$       | diatomic.   |
| 3. Quadribasic | $S_2H_4O_{10} = S_2O_2$    | tetratomic. |
| 4. Sexbasic    | $S_2H_6O_{12} = S_2$       | hexatomic.  |
| 5. Octobasic   | $S_2H_8O_{14} = S_2 - O_2$ | octatomic.  |

It is easy to apply a similar *reductio ad absurdum* to the radical theory in the case of the oxychlorides and other basic salts, and to show that the radicals of the dualists are often merely algebraic expressions.—(See further my remarks in the *Am. Jour. Science*, vii. 402—404.)†

The above, which we conceive to be a simple statement of the process as it takes place in nature, dispenses alike with hypothetical radicals and residues, both of which are, however, convenient for the purposes of notation. In the selection of a typical form, to which a great number of species may be referred, hydrogen or water merits the preference from its simplicity and from the important part which it plays in the generation of species. Water and carbonic anhydrid are both so directly concerned in the generation of the bodies in the carbon series that either may be assumed as the type, but we prefer to regard  $C_2O_4$ , like the other anhydrids, as only a derivative of the type of water, and eventually of the hydrogen type.

These views were first put forward by myself in 1848, when I expressed the opinion that they were destined to form "the basis of a true natural system of chemical classification;" and it was only after having opposed them for four years to those of Gerhardt, that this chemist, in June, 1852, renounced his views, and, without any acknowledgment, adopted my own.—(*Ann. de Chim. et Phys.* (3) xxxvii. 285.) Already, in 1851, Williamson, in a paper read before the British Association, had developed the ideas on the water type to which Wurtz refers above, and to him the English editor of "Gmelin's Handbook" ascribes the theory. The notion of condensed types, and of  $H_2$  as the primal type, was not, so far as I am aware, brought forward by either of these, and remained unnoticed until resuscitated by Wurtz in 1855, seven years after I had first announced it, and one year of my reclamation, published in the *American Journal of Science* in March, 1854.

My claims have not, however, been overlooked by Dr. Wolcott Gibbs. In an essay on the polyacid bases he remarks, that in a previous paper he had attributed the theory of water types to Gerhardt and Williamson, and adds, "In this I find I have not done justice to Mr. T. Sterry Hunt, to whom is exclusively due the credit

\* We willingly reprint this article at the request of the learned author, who is reasonably anxious that his own share in the development of the ideas now generally received should not be overlooked.—ED. C.N.

† Those who are familiar with chemical literature will remember an amusing *jeu d'esprit* of Laurent's, in which he invited the attention of the advocates of the radical theory to a newly-invented electro-negative radical *Eurhizene*.—*Comptes Rendus des Travaux de Chimie* for 1850, pp. 251 and 376. We observe a late writer in the *CHEMICAL NEWS* (vol. i., p. 326) proposing as a new electro-negative radical, under the name of hydride, the peroxide of hydrogen,  $HO_2$ , the eurhizene of Laurent.



of having first applied the theory to the so-called oxygen acids and to the anhydrides, and in whose earlier papers may be found the germs of most of the ideas on classification usually attributed to Gerhardt and his disciples." (*Proc. Am. Assoc.*, Baltimore, May, 1858, p. 197.) It will be seen from what precedes that I not only applied the theory, as Dr. Gibbs remarks, but, except so far as Laurent's suggestion goes, invented it and published it in all its details some years before it was accepted by a single chemist.

In conclusion, I have only to ask that future historians will do justice to the memory of Auguste Laurent, and will ascribe to whom it is due the credit of having given to the science a theory which has exercised such an important influence in modern chemical speculation and research, remembering that my own publications on the subject, which cover the whole ground, were some years earlier than those of Williamson, Gerhardt, Wurtz, or Kolbe.

#### *Experiments on the Action of the Air on Vegetable Fatty Oils,\* by M. S. CLOEG.*

It may be asked under what form the carbon and hydrogen are eliminated in the course of the oxidation of oils. I agree with Saussure, that a portion of the carbon passes to the state of carbonic acid, but I have, moreover, ascertained that the amount of carbonic acid produced does not nearly represent the whole of the carbon which has disappeared.

In the same way with hydrogen, part is disengaged as water, but it is also eliminated under some other form.

These facts are easily explained by the production of a carbonised volatile compound, the pungent odour of which greatly resembles that of acroleine; this is a substance which browns the sheets of unsized paper, serving to recover the oils exposed to the air.

Some old books are coloured in the same way, and I believe that this coloration is the result of the slow oxidation of the oil used in the printing ink, and the formation of a product possessing a stifling odour, similar to that which I have recognised in air which has been for about ten days in contact with a siccative oil.

#### *Process for Finding Traces of Chromium in Irons, Cast Irons, Steels, and Ores,† by M. A. TERREIL.*

THE following is a simple method by which, in exceptional cases, the presence of traces of chromium may be recognised:—

Treat the metal or ore by the ordinary processes, to separate the silica and obtain a liquid containing all the metals in solution, and in which the iron is at its maximum of oxidation; then precipitate the liquid by an excess of a very much concentrated solution of potash; then pour, drop by drop, into the solution containing the precipitate, and heated to 80° or 90°, a much diluted solution of permanganate of potash until the permanganate loses its colour; the reaction is terminated when the liquid takes a greenish tinge, owing to manganate of potash, which does not give oxygen.

Then filter, saturate the filtered liquid with acetic acid, which immediately reduces the small quantity of manganate of potash, that gave to the solution its green colour; then into the liquid, which has frequently a yellow tinge, pour acetate of lead, which determines a yellow precipitate of chromate of lead.

\* Abstract from *Bulletin de la Société Chimique*.

† *Bulletin de la Société Chimique*.

This process is equally applicable to discovering traces of tungsten, vanadium, and molybdene contained in irons, cast irons, steels, and iron ores.

## TECHNICAL CHEMISTRY.

### *Valuation of Essence of Mustard.‡*

PERFECTLY pure essence of mustard dissolves in concentrated sulphuric acid, with hardly any colouration; but the oils often fraudulently adulterated all become coloured, either red or brown, in presence of this acid.

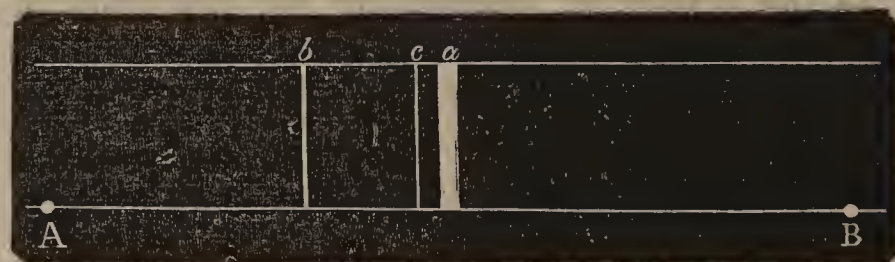
To test the essence introduce five drops of it, with fifty drops of concentrated and colourless sulphuric acid, into a small tube, and then shake them together. The colouration will soon become apparent if the essence be adulterated.

Rectified petroleum forms the exception, as sulphuric acid does not colour it, but its presence is betrayed by its insolubility in this acid. This may be proved by operating on twenty drops of essential oil; the essence of mustard dissolves, while the petroleum floats in the form of a limpid oil.

## PHYSICAL SCIENCE.

### *The Spectrum of the Great Nebula in Orion.§*

THE result of my observation is truly astonishing. The light of the nebula is almost monochromatic and green, its spectrum is simply three luminous rays, of which the position is nearly as follows:—



The first ray (a) is tolerably wide and perfectly sharp; the second (b) is narrower, and is not far from it; these two rays are visible even when regarded through the spectroscope with the naked eye. Upon adding the eyepiece a third ray (c) is seen, very fine and close to a. The ray b appears violet, but the colours are deceptive. Upon introducing into the spectroscope the light from a mixture of sodium and strontium it is seen that the group of the nebula occupies the middle place between the yellow ray of sodium and the blue ray of strontium; the light, therefore, should be green; and, indeed, upon introducing the light of a spirit lamp, the wick of which has been soaked in boric acid, it is seen that the group of the nebula nearly corresponds to the second green band of boron. For the present that will suffice, but I hope soon to fix the places of the rays in a better manner. This spectrum offers a striking contrast to those of the small stars; as soon as one of these enters the slit of the instrument a wide coloured band is seen to flash across the field of vision; this is the continuous spectrum of the star, which does not differ from that of other stars except in faintness.

This discovery is very interesting in relation to the constitution of nebulae; it shows that the mass of matter in this immense nebula is in a different state to the stars

‡ *Chem. Centralbl.*, p. 1071. 64.

§ Extract from a letter from Father Secchi to M. Faye, read before the French Academy, March 6, 1865.



themselves, as Mr. Huggins has already remarked of the planetary nebulae.||

*On the Spectrum of the Great Nebula in the Sword Handle of Orion,\* by WILLIAM HUGGINS, F.R.A.S.*

IN a paper recently presented to the Royal Society†, I gave the results of the application of prismatic analysis to some of the objects in the heavens known as nebulae. Eight of the nebulae examined gave a spectrum indicating gaseity, and, of these, six belong to the class of small and comparatively bright objects which it is convenient to distinguish still by the name of planetary. These nebulae present little indication of probable resolvability into discrete points, even with the greatest optical power which has yet been brought to bear upon them.

The other two nebulae which gave a spectrum indicative of matter in the gaseous form, are 57 M, the annular nebula in Lyra, and 27 M; the Dumb-bell nebula. The results of the examination of these nebulae with telescopes of great power must probably be regarded as in favour of their consisting of clustering stars. It was therefore of importance to determine, by the observation of other objects, whether any nebulae which have been certainly resolved into stars give a spectrum which shows the source of light to be glowing gas. With this purpose in view I submitted the light of the following easily resolved clusters to spectrum analysis:—

"4670. 2120 h. 15 M. Very bright cluster; well resolved."‡

"4678. 2125 h. 2 M. Bright cluster, well resolved."

Both these clusters gave a continuous spectrum.

I then examined the Great Nebula in the Sword-handle of Orion. The results of telescopic observation on this nebula§ seem to show that it is suitable for observation as a crucial test of the correctness of the usually received opinion that the resolution of a nebula into bright stellar points is a certain and trustworthy indication that the nebula consists of discrete stars after the order of those which are bright to us. Would the brighter portions of the nebula adjacent to the trapezium, which have been resolved into stars, present the same spectrum as the fainter and outlying portions? In the brighter parts, would the existence of closely aggregated stars be revealed to us by a continuous spectrum, in addition to that of the true gaseous matter?

The telescope and spectrum apparatus employed were those of which a description was given in my paper already referred to.

The light from the brightest parts of the nebula near the trapezium was resolved by the prisms into three bright lines, in all respects similar to those of the

gaseous nebulae, and which are described in my former paper.

These three lines, indicative of gaseity, appeared (when the slit of the apparatus was made narrow) very sharply defined and free from nebulosity; the intervals between the lines were quite dark.

When either of the four bright stars,  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  Trapezii was brought upon the slit, a continuous spectrum of considerable brightness, and nearly linear (the cylindrical lens of the apparatus having been removed), was seen, together with the bright lines of the nebula, which were of considerable length, corresponding to the opening of the slit. The fifth star  $\gamma'$  and the sixth  $\delta$  are seen in the telescope, but the spectra of these are too faint for observation.

The positions in the spectra of  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  Trapezii, which correspond to the positions in the spectrum of the three bright lines of the nebula, were carefully examined, but in no one of them were dark lines of absorption detected.

The part of the continuous spectra of the stars  $\alpha$ ,  $\beta$ ,  $\gamma$ , near the position in the spectrum of the brightest of the bright lines of the nebula, appeared on a simultaneous comparison to be more brilliant than the line of the nebula, but in the case of  $\gamma$  the difference in brightness was not great. The corresponding part of  $\delta$  was perhaps fainter. In consequence of this small difference of brilliancy, the bright lines of the adjacent nebula appeared to cross the continuous spectra of  $\gamma$  and  $\delta$  Trapezii.

Other portions of the nebula were then brought successively upon the slit; but throughout the whole of those portions of the nebula which are sufficiently bright for this method of observation the spectrum remained unchanged, and consisted of the three bright lines only. The whole of this Great Nebula, as far it lies within the power of my instrument, emits light which is identical in its characters; the light from one part differs from the light of another in intensity alone.

The clustering stars of which, according to Lord Rosse and Professor Bond, the brighter portions of this nebula consist, cannot be supposed to be invisible in the spectrum apparatus because of their faintness, an opinion which is probably correct of the minute and widely separated stars seen in the Dumb-bell nebula, and to which reference was made in my former paper. The evidence afforded by the largest telescopes appears to be that the brighter parts of the nebula in Orion consist of a "mass of stars;" the whole, or the greater part of the light from this part of the nebula, must therefore be regarded as the united radiation of these numerous stellar points. Now, it is this light which, when analysed by the prism, reveals to us its gaseous source, and the bright lines indicative of gaseity are free from any trace of a continuous spectrum, such as that exhibited by all the brighter stars which we have examined.

The conclusion is obvious, that the detection in a nebula of minute closely associated points of light, which has hitherto been considered as a certain indication of a stellar constitution, can no longer be accepted as a trustworthy proof that the object consists of true stars. These luminous points, in some nebulae at least, must be regarded as themselves gaseous bodies, denser portions, probably, of the great nebulous mass, since they exhibit a constitution which is identical with the fainter and outlying parts which have not been resolved. These nebulae are shown by the prism to be enormous gaseous systems; and the conjecture appears probable that their apparent permanence of general form is maintained by

|| Mr. Huggins has already anticipated the above discovery in a paper communicated to the Royal Society on January 26 last, which we publish in this number.—ED. C. N.

\* Read before the Royal Society, January 26, 1865.

† "On the Spectra of Some of the Nebulae." *Phil. Trans.*, 1864, p. 437.

‡ The numbers and descriptions are from Sir John Herschel's Catalogue, *Phil. Trans.*, 1864, Part I.

§ "The general aspect of the less luminous and cirrus portion is simply nebulous and irresolvable; but the brighter portion immediately adjacent to the trapezium forming the square front of the head, is shown with the 18-inch reflector broken up into masses, whose mottled and curdling light evidently indicates, by a sort of granular texture, its consisting of stars, and when examined under the great light of Lord Rosse's reflector, or the exquisite defining power of the great achromatic at Cambridge, U.S., is evidently perceived to consist of clustering stars. There can therefore be little doubt as to the whole consisting of stars too minute to be discerned individually even with these powerful aids, but which become visible as points of light when closely adjacent in the more crowded parts."—Sir John Herschel, "Outlines of Astronomy," seventh edition, pp. 651, 622.



the continual motions of these denser portions which the telescope reveals as lucid points.

The opinions which have been entertained of the enormous distances of the nebulae, since these have been founded upon the supposed extent of remoteness at which stars of considerable brightness would cease to be separately visible in our telescope, must now be given up in reference at least to those of the nebulae the matter of which has been established to be gaseous.

It is much to be desired that proper motion should be sought for in those of the nebulae which are suitable for this purpose; indications of parallax might possibly be detected in some, if any nebulae could be found that would admit of this observation.

If this view of the greater nearness to us of the gaseous nebulae be accepted, the magnitudes of the separate luminous masses which the telescope reveals as minute points, and the actual intervals existing between them, would be far less enormous than we should have to suppose them to be on the ordinary hypothesis.

It is worthy of consideration that all the nebulae which present a gaseous spectrum exhibit the same three bright lines; in one case only, 18 H.IV., was a fourth line seen. If we suppose the gaseous substance of these objects to represent the "nebulous fluid" out of which, according to the hypothesis of Sir William Herschel, stars are to be elaborated by subsidence and condensation, we should expect a gaseous spectrum in which the groups of bright lines were as numerous as the dark lines due to absorption which are found in the spectra of the stars. Moreover, if the improbable supposition be entertained, that the three bright lines indicate matter in its most elementary forms, still we should expect to find in some of the nebulae, or in some parts of them, a more advanced state towards the formation of a number of separate bodies, such as exist in our sun and in the stars; and such an advance in the process of formation into stars would have been indicated by a more complex spectrum.

My observations, as far as they extend at present, seem to be in favour of the opinion that the nebulae which give a gaseous spectrum, are systems possessing a structure, and a purpose in relation to the universe, altogether distinct and of another order from the great group of cosmical bodies to which our sun and the fixed stars belong.

The nebulous star,  $\epsilon$  Orionis was examined, but no peculiarity could be detected in its continuous spectrum.||

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, March 16.

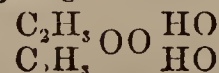
Professor A. W. WILLIAMSON, Ph.D., F.R.S., President, in the Chair.

AFTER reading the minutes and acknowledging the several donations to the library, the ballot was taken for Dr. William Johnson, Newcastle-upon-Tyne, and Mr. George Jones, 106, Leadenhall Street, London, each of whom was declared to be duly elected a Fellow of the Society. The names of the following candidates were read for the second time, viz.:—Capel H. Berger, Esq., Lower Clapton; Alexander W. Gillman, Esq., Southfield, Wandsworth; Arthur S. Hobson, Esq., Turnham Green; George B. Robertson, Esq., Stamp Office, Somerset House, and Upper Holloway; Robert Barton, Esq., Bushy Park, Teddington;

|| Admiral Smyth appears to have always maintained that the results of telescopic observation on the nebulae were insufficient to support the opinion that all these objects were probably of stellar constitution. See his "Cycle of Celestial Objects," vol. i., p. 316, and his "Speculum Hartwellianum," pp. 111-114.

William Chrispin, Esq., Darlington, Durham; William Judd, Esq., Christchurch, Hants; and Michael Foster, jun., M.D., Huntingdon. For the first time were proposed the names of Arthur Clegg Bowdler, Esq., Oxford Road, Manchester; and W. E. Heathfield, Esq., F.R.G.S., Princes Square, Finsbury.

Professor J. A. WANKLYN read a paper "*On Vapour-Densities.*" The author protested against the practice of employing a high temperature in experiments made for the purpose of determining the vapour-densities and formulæ of chemical compounds, on the ground that there was increased liability to decomposition, and when, as frequently happened, the results obtained at such high temperatures did not coincide with those taken at lower degrees of heat, there was no indication to show which number was entitled to be received with confidence. An extensive series of experiments had been made by Dr. Playfair and the author upon vapours heated to various points ranging between 10° and 40° C. above the boiling points of the corresponding liquids, and the conclusions established were to the effect that at the lowest possible temperature consistent with the production of truly gaseous vapours the results were one- or two-tenths higher than those furnished by the employment of superior temperatures. Some few substances, particularly sulphur and acetic acid, had vapour-densities which, taken at 40° C. above their boiling points, depart from the theoretical numbers by units instead of by tenths; and sometimes by heating the vapours of these substances still higher they become of the theoretical value. In other instances the superheating to the extent of 40° gave irregular results, and the vapours were found to be decomposed. The author then referred to his former experiments in which the vapour density was determined successfully by removing the pressure, instead of elevating the temperature, whilst the body was under examination; or, working on a practically identical system, he mixed the vapour with a known volume of a permanent gas, and thus obtained very accurate determinations. With reference to Cahour's maxim "Heat your vapour 40° C. above the boiling-point of the liquid," the speaker preferred to advise "that the determination be made at the lowest temperature that is practicable." Respecting the slight increase in the vapour-density observed whenever the vapour was heated only 5° or 10° above the boiling-point of the liquid, the author remarked that this increase was due not so much to any alteration in the co-efficient of expansion as to absorption by the walls of the vessel which was used to contain the vapour (Magnus). By way of explaining the anomalies observed in the instances of sulphur and acetic acid, the author suggested that each of these substances might be capable of combining with itself, and so producing complex bodies of different molecular weights. The existence of the element sulphur in several allotropic modifications seemed to favour this view; and he saw no difficulty in regarding acetic acid as a bibasic acid, and assigning to it a double formula; thus:—



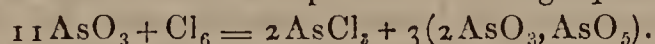
Acetic acid exhibits a tendency to form double salts with monatomic bases; it forms a compound with butyric acid—i.e., butyr-acetic acid, an acid of great stability, and formerly mistaken for propionic acid. On the other hand, the state of condensation of chloride of acetyl and of acetic ether point to the existence of an acid having the formula  $\text{C}_2\text{H}_3\text{OHO}$ , which coincides with the result obtained on heating acetic acid vapour to temperatures above 200°C.

The arguments brought forward by Professor Wanklyn were warmly contested by the President, Professor Frankland, and by Dr. Odling, who also objected to the author's communication on the score of want of novelty.

A note "*On the Action of Chlorine upon Arsenious Acid,*" by Professor C. L. BLOXAM, was read by the SECRE-



TARY. The author attempted to prepare a large quantity of terchloride of arsenic by passing a current of chlorine gas over a heated mixture of arsenious acid and carbon, and was surprised to find that the product did not nearly amount to the calculated proportion. Upon examining the residue in the retort there appeared to be much arsenic acid formed, which the joint influence of carbon and chlorine was unable to decompose. This observation led to a closer study of the reaction, and the author found that the presence of carbon did not affect the result, and ultimately he arrived at the following conclusion—viz., that the action of chlorine upon arsenious acid at a moderate heat consists in the oxidation of one portion of arsenious acid at the expense of another, the arsenic of which is converted into terchloride, whilst the arsenic acid which has been thus formed combines with the remainder of the arsenious acid to form a transparent glass, having the composition  $2\text{AsO}_3\text{AsO}_5$ , which may also be produced by heating arsenic acid with an excess of arsenious acid. The result of Prof. Bloxam's quantitative experiments led him to adopt the following equation:—



The PRESIDENT remarked upon the interest of the reaction pointed out by Professor Bloxam, and recurring to the subject of vapour-densities, he was reminded of the anomalous result furnished by the vapour of arsenious acid, which occupied a double volume. Its constitution might be accounted for by supposing some of the metal to exist as a base, in the compound of four atoms of arsenic and six of oxygen.

Professor A. H. CHURCH, M.A., exhibited a fine specimen of the new mineral, Tallingite, on quartz, which he had received from Cornwall since describing the results of his analysis at the last meeting of the Society. He likewise showed a specimen of Melanconite, or native black oxide of copper, from Cornwall, which was so pure that it contained upwards of 99 per cent. of cupric oxide. The dark steel-grey crystals of this mineral belonged to a trimetric system, and were not monometric, as had been commonly supposed. For a fuller account of its mineralogical character we refer to Professor Church's note published last week in this journal (page 122).

Professor CHURCH finally made a statement respecting the action of nitrate of silver upon ebonite, to which his attention had been called by Mr. Hockin. Since this material had been applied to photographic use, and baths made of it were employed to hold solutions of nitrate of silver, it had been frequently noticed that the reaction of the neutral liquid became acid, and that a deposit, apparently of sulphide of silver, was formed on the interior surfaces of the ebonite vessel. Analysis gave 52 per cent. of silver and 8 per cent. of sulphur, in a portion scraped from the lining of a photographic bath, and these proportions nearly coincided with the numbers demanded for sulphide of silver. There were also traces of copper and other metals, but the most remarkable feature was the peculiar deflagration which ensued on heating the powder; sulphur vapours were given off, and spongy silver remained in the test-tube. (Mr. Church illustrated this point by an experiment.)

Mr. SPILLER said that he had examined many samples of ebonite with a view to their photographic application, and whilst he found some varieties behave in the manner described by Prof. Church, he had met with other samples of superior manufacture and purity which were proof against the action of silver solution of the strength commonly employed in the collodion process. He had always supposed the deposit to consist of pure metallic silver, and not the sulphide, and he believed the reduction of the metal to be due to the presence of metallic particles in the bronze powders and various pigments, commonly introduced into vulcanised india-rubber, from the refuse cuttings of which ebonite was frequently manufactured; but since Mr. Silver had, upon the speaker's recommenda-

tion, adopted the use of pure india-rubber and sulphur only in the production of ebonite for photographic purposes, the employment of such apparatus had gained in favour.

Professor FRANKLAND confirmed Mr. Spiller's observations with regard to the ordinary composition of ebonite. He had occasion, a year or two since, to examine a series of samples and experiment upon the manufacture. As the result, it was found that not only sulphur, but almost any metallic sulphide, was capable of hardening india-rubber when exposed to the proper temperature; the sulphides of arsenic and antimony could be used, and he succeeded in making ebonite, or vulcanite, containing as much as 20 per cent. of sulphate of magnesia.

The meeting then adjourned until Thursday evening, 30th instant, which will be the occasion of the Society's anniversary. The election of officers for the ensuing year and other business will be proceeded with at the usual hour, eight o'clock.

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 7, 1865.

R. ANGUS SMITH, Ph.D., F.R.S., &c., President, in the Chair.

A PAPER "On the Action of Sea Water upon certain Metals and Alloys," was read by F. CRACE CALVERT, Ph.D., F.R.S., F.C.S., &c., and R. JOHNSON, F.C.S., which we shall publish in our next.

Mr. JOHN ROBINSON exhibited specimens of iron and brass which had been acted upon by the water of the river Medlock, and stated he had found that an alloy of lead, tin, and antimony resisted the action of sea water better than any other metal or alloy he had tried.

## PHOTOGRAPHIC SECTION.

March 2, 1865.

Mr. JOHN PARRY in the Chair.

Mr. DANCER read a paper entitled, "The Opaque Microscope not New," in which he proved that the so-called new instrument was of very old date, and was described and used previous to the year 1780; and that an improved form of it was exhibited nightly at the Manchester Mechanics' Institution in the winter of 1840—1841.

Mr. SIDEBOTHAM exhibited some prints taken by the Wothlytype process, and described the mode of their production. Others printed by the ordinary silver process from the same negatives were also exhibited, and pronounced to be superior in every way.

Mr. BROTHERS exhibited two photographic prints taken by Mr. Pouncy, of Dorchester, one of them obtained direct from the negative in printers' ink, the other printed from stone. Mr. Brothers also exhibited, with a copying camera, the mode of obtaining photographs of microscopic objects by burning magnesium; also a negative and a print from it of an insect dissection so enlarged.

## ACADEMY OF SCIENCES.

March 13, 1865.

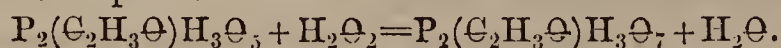
M. CHEVREUL continued and finished his historical account of the ideas entertained respecting air before the complete discovery of oxygen. In this paper he reviews the ideas and experiments of Priestley, Scheele, and Lavoisier, giving to the first, without qualification, the praise of being the first to recognise and determine the properties of oxygen. He next details with great fairness the various discoveries—too little known—of Scheele, "the humble pharmacien of a small town in Sweden;" and lastly comes to Lavoisier, who settled beyond dispute the composition of the air, and enunciated the theory of combustion.

M. Berthelot continued his paper "On the Calorific Phe-



*nomina which Accompany the Formation of Organic Combinations,"* treating in this of the formation of aldehyds, acids, ethers, amides, &c. We leave this paper for a longer abstract than we can give here.

M. Menschutkin presented a note "*On the Acetopyrophosphates.*" The author has already described acetopyrophosphorous acid, which he has since attempted to oxidise by means of nitric acid. By this reaction he only obtained a white crystalline mass, which he could not analyse. He therefore had recourse to another oxidising agent,—peroxide of hydrogen—by which the desired result was accomplished.



The method adopted for the preparation of the baryta salt was as follows:—Peroxide of barium was dissolved in just enough dilute hydrochloric acid to give a clear liquid; a solution of acetopyrophosphate of potash was then added, and after a time a crystalline precipitate fell, which proved to be the baryta salt desired. The salts of silver and lead were prepared by means of the baryta salt.

By long boiling with ether acids or alkalies acetopyrophosphoric acid is converted into phosphoric.

M. Salet presented a short note "*On the formula of Liquid Chloride of Cyanogen.*" To this body, discovered and described by Wurtz eighteen years ago, the discoverer first attributed the formula  $Cy_2Cl_2$ , which he subsequently halved. The author of this note has made careful determinations of the vapour density, in which he finds no irregularities, and which correspond exactly to the theoretic density required by the formula  $CyCl$ . M. Salet remarks that Serrullas' gaseous chloride of cyanogen, to which the formula  $CyCl$  is also attributed, presents with the liquid chloride a curious example of isomerism.

M. Maisonneuve exhibited and described a new form of lithotrite, or lithotribe, as he has named it. One arm of this instrument is hollow, and thus at any stage of the operation water can be injected into the bladder without removing the instrument. It is, of course, equally possible to distend the organ with a gas, as carbonic acid, when liquids set up much irritation.

Botanists will find in this number of the *Comptes Rendus* an interesting paper "*On the Lactiferous Vessels of the Papaveraceæ.*"

## NOTICES OF BOOKS.

*Report on the Air of Mines and Confined Places.* By ANGUS SMITH, Ph.D., F.R.S. Part of the Appendix to the Report of the Royal Mines Commission. 1864.

[SECOND NOTICE.]

OUT of doors it is found that the proportions of oxygen and carbonic acid vary but slightly from what we have called the normal standard. Within inhabited houses, places of amusement, &c., as might be expected, greater differences are observed. Leblanc was one of the first experimenters who entered upon the examination of the air of houses, theatres, &c., and remarked in these the diminution of oxygen and the great increase of carbonic acid. We need not quote the results at length, which show us that in the air of a bedroom he found more than one per cent. of carbonic acid (by weight), and in the Opera Comique 0.43 per cent. We may come nearer home, and see what Dr. Smith himself found in Manchester and Dr. Bernays in London. In the pit of the Theatre Royal of Manchester Dr. Smith found 0.27 per cent., and at the ceiling of his own study 0.156 per cent. of carbonic acid. In the pit of the Standard Theatre, London, Dr. Bernays found 0.32 per cent., and even in an office in Chancery Court, at three feet from the ground, 0.2 per cent. (by volume). Pettenkoffer made many analyses of the air of inhabited places in Munich, and found as much as 0.536 of carbonic acid in some. He also studied the effects

of breathing air so contaminated, and came to the conclusion that "1 per 1000 marks the limit of good and bad air, and that those who can plead for more have lost the refined use of their senses." The ill effects, however, cannot altogether be ascribed to the carbonic acid, but to the offensive organic emanations which invariably accompany it. The depressing feeling that arises from breathing such air, he attributes to butyric and valerianic acids which are present in such an atmosphere. With these remarks let us pass to the air of mines.

Dr. Smith first reviews the labours of his predecessors. We notice at starting the experiments of Mr. Moyle on the air of the Cornish mines. He collected the air by emptying bottles of water, and thus, Dr. Smith believes, must have lost some carbonic acid. Dr. Smith therefore recalculates the results, giving an amount of carbonic acid equal to the oxygen removed, and thus arrives at the conclusion that in these Cornish mines the proportion of oxygen varied from 19.34 to 15.51 per cent. Here is a serious diminution; and Mr. Moyle remarked that in the last specimen a candle burned with difficulty. Mr. Robert Hunt has also made some analysis of the air of Cornish mines, finding in some as little as 17 per cent. of oxygen.

Brockman and Bodeman have examined the air of the Upper Harz Mines, and their experiments yielded the following average results:—

Oxygen.	Carbonic Acid.
19.79	1.39

Dr. Smith's analyses extend to many hundreds, but before giving his results we will quote at some length his method. The specimens were collected in tubes three-quarters of an inch in diameter and six inches long, drawn out at each end. Air was drawn through them by means of a bellows' aspirator, and then the tubes were sealed. To make sure that the sealing was good, the ends were examined by a lens or dipped under mercury. Removed to the laboratory, the sealed ends were broken under mercury, and the air transferred to an absorption tube. The carbonic acid was then absorbed by a moist ball of caustic potash. In general, Dr. Smith found that in twelve hours the absorption was complete. At first he determined the oxygen by means of pyrogallic acid, but afterwards gave the method up because of the difficulty of washing the tubes from the strongly coloured liquid, and the probable error from the production of carbonic oxide. He then resorted to the method by explosion, using Bunsen's eudiometer, and exploding with a small Rhumkorff's coil, and in this way got quickly through an immense number of analyses. The accuracy of these were conscientiously tested, and thus Dr. Smith is able to say that the determinations of oxygen he believes to be correct to a small fraction. The same minute accuracy, however, is not to be expected in the carbonic acid. "The amount being extremely small, and the amount of air being extremely small, there was more risk of error."

The results of all these analyses are given in a table of great length. It will be sufficient for our purpose to quote the summary.

### Summary of Analyses.

Oxygen, average of 399 experiments	20.26
" of ends . . . .	20.18
" of other parts . . . .	20.32
" in currents . . . .	20.65
" in large cavities . . . .	20.77
" just under shafts . . . .	20.42
" in sumps . . . .	20.14
Carbonic acid . . . .	0.785
35, or 10.67 per cent., normal, or nearly so.	
81, or 24.69 per cent., decidedly impure.	
212, or 64.63 per cent., exceedingly bad.	

We have already explained that Dr. Smith considers normal air to contain 20.9 of oxygen; that containing



20·6 he considers decidedly impure; and 20·5 he sets down as exceedingly bad and dangerous.

Dr. Smith then proceeds to the causes of this deterioration of the atmosphere in mines.

(To be continued.)

*Cooley's Cyclopædia of Practical Receipts, &c.* Fourth Edition, Revised and Enlarged by ARNOLD J. COOLEY and J. C. BROUGH. London: John Churchill and Sons. 1864. Pp. 1393.

THE progress of chemistry, pharmacy, and technology during the past few years has rendered the publication of a new edition of this well-known work a matter of necessity. Cooley's "Cyclopædia," in its old form, is too well known to most of our readers to need any description or praise from us; we shall, therefore, limit our remarks upon it to pointing out the improvements and additions it has received from its old editor, Mr. Cooley, and from his worthy successor, Mr. J. C. Brough. In the preface we are told that the articles under the letters A and B were written entirely by the first-named gentleman, but that owing to general ill-health and a frightful accident, Mr. Cooley was unable to continue his task. The remainder of the book was therefore placed in the hands of Mr. Brough for completion.

Amongst the general improvements the work has received may be mentioned the increased size of the pages, which contain about 25 per cent. of additional matter, the margins of course being proportionately smaller. Besides this, the number of pages has also been increased. The type in which the work is printed has been judiciously altered, the catch words being in a thickened letter, and several different signs are used to denote where synonyms are obsolete, colloquial, or vulgar. These typographical aids to ready reference will be appreciated by the man of business, who has but little time to spend in hunting up the words he requires.

Turning to various articles as tests, we find that many important words, such as "acidimetry," "alkalimetry," and "alcoholometry," have been greatly enlarged, the table of the real strengths of spirituous solutions at different temperatures under the latter word being most elaborate. Under Alkaloids we find Stas's and Fresenius's methods of detection and extraction given at great length. "Carbolic acid," "collodion," and "crucibles" also receive special attention. The article on Dialysis is a little essay on the subject, and deserves republication. Under Equivalents, a table giving the old and new formulæ of all the more common chemical compounds will be found. The following articles, taken at random, are also greatly enlarged, the latest information being given on the subjects of which they treat:—Furnaces, Hypophosphites, Lamps, Iodine, Safety Matches, Chlorodyne, Phosphorus, Pyroxylin. As a specimen of the care which has been taken to bring the information conveyed in the work down to the present day, we may mention that the following words all receive full attention:—Cæsium, dialysis, leucaniline, rubidium, spectral analysis, thallium, and many others of less importance.

The British Pharmacopæia made its tardy appearance too late to receive a due amount of attention in the body of the book. Rather, therefore, than wait for its advent, the editors wisely chose to convey the information published in that much-abused work in the form of an appendix. This has been done with great care by Mr. Brough, who has cleverly contrived to put the matter into the smallest possible space.

We feel sure that little more need be said to convince our readers that the present edition is a most worthy successor, both in quality and quantity, to the preceding ones; and the editors deserve the greatest praise for the painstaking and judicious manner in which they have put a new face on an old friend.

*A Suggestion as to the Feeding of Milch Cows, with a view to Improvement in the Constituents of the Milk.* By HUMANITAS. London: Booth. 1865.

THAT the nature of the food to some extent alters the milk of the cow there can be no doubt. Nature intended cows to feed on grass, and we question whether any improvement can be made on that diet. A London cow, fed on sour grains in a dark cellar, cannot be expected to yield milk of the same quality as one that roams and feeds at will in the open air. Some improvement in the food of London cows might, no doubt, be made, and the suggestions of the author may deserve attention.

With regard to the composition of human and cow's milk, the writer may perhaps be somewhat enlightened by a perusal of the article "Milk," in the last number of "Watts' Dictionary of Chemistry." It will there be seen that the differences are not so great as seems to be imagined.

*Journal für Praktische Chemie.* Nos. 23 and 24, 1864.

THIS double number of the Journal completes the volume for 1864. It opens with an article by F. J. Ruprecht, "On the Origin of Tschornosjom," the black earth, of wonderful fertility, which covers about a third of Russia in Europe. Geologists, chemists, and microscopists have at different times sought to explain the origin of this deposit, but without success. The chemist finds an unusually large proportion of humus, with potash, soda, and as much as  $\frac{1}{2}$  per cent. of phosphoric acid. The microscopist finds no traces of marine organic forms (which is conclusive against its having formed the bottom of a sea), nor of vegetable organic structure, but observes numbers of the phytolithites which commonly occur in grasses. The author of this paper seems to consider that the earth results from the complete decomposition of grass sod.

Another contribution from Russia is a short notice by J. Tuttschew, "On some Naphthas sold in Kieff," both of American origin. There is nothing to be noticed in the account of these, but an experiment deserves mention. The author passed the vapour of one, to which he attributes the formula  $C_4H_4$ , through a red-hot tube filled with pumice stone, and obtained a quantity of gas and a tarry residue. A gramme of the naphtha yielded about a litre of gas, which had the following volume percentage composition:—

Acetylene . . . . .	1·77
Elayl and homologues . . . . .	20·51
Residue (marsh gas and hydrogen) . . . . .	77·72

A paper by Leuchs, "On the Nutriments of Yeast and their Relative Value," details a number of experiments undertaken to discover upon what food, and under what circumstances, the yeast plant becomes most developed. We need not quote much of the paper, but it may be useful to some to know that a solution of twelve to fifteen parts of sugar in a hundred parts of water is most advantageous for fermentation.

A long paper by Borodin, "On the Action of Sodium on Valeraldehyd," is thus summed up by the author:—

1. By the action of sodium on valeraldehyd hydrogen is expelled: the substance containing sodium which is formed, is not a simple substitution product, but a mixture.

2. Water decomposes this mixture.

3. Among the decomposition products valeraldehyd is again found with isomeric and polymeric bodies, accounting for the absence of valeraldehyd of sodium in the original substance.

4. The decomposition products are probably caustic soda, valerianate of soda, amyl-alcohol, and two new bodies,  $C_{10}H_{22}O$  and  $C_{10}H_{18}O$ .

5. The valerianic acid is formed at the expense of the oxygen of the aldehyd, and is not a by-product of the oxidation of the aldehyd in the air.



6. The body  $C_{10}H_{22}O$  is a monatomic alcohol identical with, or an isomer of, capric acid.

7.  $C_{10}H_{18}O$  is a neutral body, the chemical nature of which is yet undetermined, but which appears to contain replaceable hydrogen.

"On the Salts of  $\beta$ -nitrobenzoic Acid, and the Action of Zinc on their Ammoniacal Solutions," is a short paper by Solokoff. The reaction mentioned yielded Zinins' azobenzoic acid.

Dr. Hahn, in a paper "On the Compounds of Selenium with Phosphorus," describes a number of definite compounds of these two bodies, and some double compounds with metallic selenides.

The next article is by Dr. Classen, "On the Salts of Tetraethyl-ammonium Oxide with Oxidizing Acids, and their Decomposition Products on Destructive Distillation." The author experimented with the tungstate, molybdate, stannate, antimonate, chromate, arsenate, &c. The three last-named salts, on dry distillation, yielded aldehyd, and some gave alcohol and acetic acid, the formation of which is easily explained. The molybdate, tungstate, and stannate gave neither.

Schönbein, in a paper "On the Proximate Cause of the Alkaline Fermentation of Urine," points out the existence of a ferment in normal urine, and shows that the thread-like fungus which deposits in stale alkaline urine is, after well washing, capable of immediately setting up the change in fresh urine. The odour of decomposing urine he believes to arise from the decomposition of a sulphur compound, a natural constituent of the fluid already noticed by Stadeler and Pettenkofer.

The short notice of a paper by Professor Gerlach, "On the Photographic Representation of Injection Preparations in their Natural Colours," mentions a method by which the author is said to obtain naturally coloured pictures, and we shall return to it again.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

2748. A. Estourneaux and L. Beauchamps, "Certain improvements in non-conducting composition for preventing the radiation or transmission of heat or cold."—Petition recorded Nov. 7, 1864.

2969. M. A. F. Mennons, Rue de Dunkerque, Paris, "Improvements in hot blast furnaces."—A communication from N. de Telescheff, St. Petersburg.—Nov. 29, 1864.

512. W. E. Newton, Chancery Lane, "An improved mode of preparing fertilising compounds or artificial manures."—A communication from G. A. Leibig, Baltimore, U.S.A.

515. A. Meyer and M. Meyer, Liverpool, "Improvements in preparing explosive compounds."—A communication from W. Gerhardt, Schnackenburg, Hanover.—Feb. 23, 1865.

516. J. Jacob and R. Pilzinger, Dudley, "Improvements in the method of and apparatus for generating heat."

528. J. Nicholas, Aspull, Lancashire, "Improvements in converting coal oil into gas suitable for use as an illuminator."—Feb. 24, 1865.

532. T. Routledge, Sunderland, and T. Sutherland, Newcastle-upon-Tyne, "Improvements in the treatment and utilisation of certain products obtained in the manufacture of paper or paper stock."

534. F. Claudet, Coleman Street, London, "Improvements in the preparation of certain iron ores or residues for use in the blast furnace."—February 25, 1865.

546. G. K. Geyelin, South Hackney, "An improvement in air-tight jars for preserving eggs and fruit, and such like articles of food."—February 27, 1865.

564. J. Fordred, Blackheath, Kent, "Improvements in treating certain hydrocarbon oils, and in vessels for containing the same."—February 28, 1865.

571. J. Young, Manchester, "Improvements in distilling bituminous substances, and in apparatus employed therein."

572. G. H. Barth, Highfield Villas, York Road, St. Pancras, "Improvements in condensation and refrigeration of vapours and fluids."

574. C. J. Falkman, St. Petersburg, "Improvements in apparatus for distilling, purifying, and storing spirituous liquors."—March 1, 1865.

### NOTICES TO PROCEED.

2704. W. Smith, Salisbury Street, Strand, "Improvements in tanning leather, and in the apparatus to be employed for that purpose."—A communication from Mons A. Jullien, Nantes, France.—Petition recorded November 2, 1864.

2719. C. H. Garton, Bristol, and Thomas Hill, Southampton, "Improvements in brewing, fermenting, racking, and bottling beer, ale, and wine."

2723. H. W. Speneer and J. E. Ball, Willow Terrace, Bermondsey, "An improved method of manufacturing glue and size."—Nov. 3, 1864.

2733. F. Yates, Birmingham, "Improvements in the manufacture of steel and malleable cast iron, and in apparatus to be used in such manufacture."

2734. F. Yates, Birmingham, "Improved apparatus for generating combustible gases."—Nov. 4, 1864.

2762. A. Field, Lambeth Marsh, "Improvements in the manufacture of night-lights."—Nov. 7, 1864.

2766. R. Rimmer, Crowe Hall, Suffolk, "Improved apparatus for drawing off liquids."—Nov. 8, 1864.

2785. J. Dale and H. Caro, Manchester, and C. A. Martins, Warrington, "Improvements in obtaining colouring matters for dyeing and printing."—Nov. 9, 1864.

2788. J. A. Manning, Inner Temple, "Improvements in the collection and treatment of night soil."—Nov. 10, 1864.

2858. M. Destrem, Rue Lamartine, Paris, "An improved composition for painting."—Nov. 21, 1864.

3073. J. Ramsbottom, Crewe, Cheshire, "Improvements in the manufacture of steel and iron, and in the apparatus employed therein."—Dec. 12, 1864.

3115. W. Bardwell, Great Queen Street, Westminster, "An improved method of utilising sewage and urine, and for facilitating their passage through pipes, thereby preventing the pollution of rivers and streams."—Nov. 16, 1864.

3160. H. Bird, Berkeley Street, Cheltenham, "Improvements in treating sewage matters."—Dec. 20, 1864.

173. J. Hewes, West Bromwich, "Improvements in puddling, heating, and other reverberatory furnaces used in the manufacture of iron and steel, and for other purposes, which improvements may also be applied to steam boiler furnaces."—Jan. 20, 1865.

374. E. Leigh, Manchester, "Improvements in furnaces for smelting iron ores, commonly called blast furnaces, also in eupolas used in foundries for rendering down or melting iron or other metals."—Feb. 10, 1865.

473. J. G. N. Alleyne, Butterley Ironworks, Alfreton, Derbyshire, "Improvements in puddling furnaces, and in apparatus connected therewith."—February 18, 1865.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday, March 28, at 3 o'clock, Professor Masson, "On Recent British Philosophy." Thursday, March 30, at 4 o'clock, Charles Newton, Esq., "On Recent Acquisitions to the British Museum from Rhodes, &c." Friday, March 31, at 8 o'clock, James Glaisher, Esq., "On Aerial Researches." Saturday, April 1, at 3 o'clock, Professor Marshall, "On the Nervous System."



## CORRESPONDENCE.

### Continental Science.

PARIS, March 22.

THE French are in general a sceptical nation, but there is one thing in which most Frenchmen firmly believe, and that is, in the possibility of flying through the air like a bird. It is of no use that M. Babinet and other philosophers learnedly set before them the difficulties in the way of a body heavier than air rising in that medium; they see those difficulties overcome in a hundred ways every day. Sufficient force properly applied is all that is wanted to overcome gravity and establish equilibrium in the air. Heat is, of course, the force to which every one looks for support, but how to apply it? M. Landelle proposes to apply the principle of the screw, but I do not think he has yet raised himself above the ground. M. de Groof, too, has a machine in hand, nearly finished, and the completion of which is only delayed by the difficulties unavoidable in the construction of entirely new apparatus. In the meantime, M. Menuisier and other experimenters have fallen back upon first principles, and made gigantic wings of feathers, by means of which they have really, by their own strength, raised themselves in the air—*quelques centimetres*—say, an inch or so! Who, then, can question the possibility of human aviation? Still, the result is not great, and some enthusiasts have placed 5000 francs at the disposal of the Société d'Encouragement as a prize for the inventor who shall discover a method of travelling in the air by means of apparatus heavier than air.

From the regions of the air and speculation I may descend at once to the depths of the ocean, and call your attention to the ideas of MM. Pelegrin and Gabeiron, who propose a light and cheap cable for ocean telegraphy. Light cables have hitherto failed, or rather, have not been successfully laid; but the authors propose one perfectly flexible, to be sunk by weights attached at intervals as it paid out, and so contrived that they release the cable when at the bottom. Seeing, too, that heavy cables have been broken in the paying out by the strain and weight, they suggest for these a series of floats, which will take off much of the strain and allow the cable to sink gradually. These ideas are, perhaps, worthy the attention of ocean telegraphists, and you will find them at length in *Les Mondes* for the 16th of this month.

In the same journal you will find a mention of a new commutator, by means of which if you have a battery of twenty or more cells at work, you may make use of two, four, or indeed any number of couples. The thing has been patented in England, so it would be useless to describe it fully, but I may say that it consists of a wooden cylinder covered with bands of copper, which are numbered, and so arranged that each number is brought into connexion with the same number of cells. So when all your connexions have been made you have only to turn the cylinder, and without touching the battery you can use just as many cells as you please.

While on this matter, let me tell you that you may soon expect a revelation. The question "What is electricity?" is generally replied to one with the simple answer "It is electricity." We know of various manifestations of the force, but as to its nature all have hitherto been silent. M. Baille, however, has thought over the matter, and strongly hints that he is able to explain what electricity is. I shall be glad to see his explanation.

I see a very useful contrivance described by Erlenmeyer for managing the application of heat in the distillation of liquids with high boiling-points. A sand-bath, as everybody knows, is a very inconvenient arrangement, and a clay-coated retort is often out of the question. The Doctor therefore suggests surrounding the retort with short fibres of asbestos, which he keeps in their place by

means of a wire gauze. Such an asbestos bath appears to me very simple, and will no doubt be perfectly efficacious.

In my last I showed you how a tape-worm might possibly conduce to the enjoyment of a man well provided with the means of filling his stomach. But every one is not so well provided. Chamfort said with much truth that society is composed of two great classes—those who have more dinner than appetite and those who have more appetite than dinner. The latter class clearly can have no enjoyment with a tape-worm, so they may rejoice to know that it is easy to get completely disembarrassed of the parasite. A dose of ether administered in a capsule or in some syrup produces anæsthesia in the worm, who in this state relaxes his hold of the mucous membrane, and is swept away into the rectum, from which he is effectually dislodged by a small dose of castor oil. The dose of ether (60 grammes) looks large, but M. Lortet does not say that any evil consequences follow, while the anthelmintic effect is certain.

Perhaps some reader of the CHEMICAL NEWS is fond of artichokes. I am myself; but I always complain that it is an expensive *plat*, because there is so little of them to eat. This, however, it seems, can be remedied, and I give you the means by which their size may be greatly increased, and all the leaves made edible. When the head (or bottom) attains the size of an egg, a deep incision is made into the stem. This, it is said, arrests the development of the fruit, while the leaves go on increasing in size; and now, to get the whole white and soft, you have only to sentence the plant to partial death by putting a black cap on the head.

In whatever art or science England may be behind, she more than holds her own in photography. The photographic journals here are mostly filled from English sources, and English processes are generally adopted. At the last sitting of the Photographic Society, M. Loewe sent a description of a new process of heliographic engraving, but forwarded no proofs by which the value of it could be decided. It looks a hopeful process, so I send it.\* At the same meeting, MM. Marechal and Motay exhibited a collection of vitrified proofs and photolithographic prints, but did not describe their process because the English patent was not then completed. You will hear of it soon from another source.

M. F. Thomas read a note giving a process for the *estimation of chloride of platinum in chloride of gold*, which he says is extremely simple. To a solution of the suspected salt he adds a solution of nitrate of silver drop by drop as long as a precipitate is produced. The precipitate consists of chloride of silver and auric acid, and any platinum will be in solution. This, therefore, is to be boiled, saturated with carbonate of soda, and the platinum precipitated as a chloroplatinate by means of sal ammoniac. The mixed precipitate of chloride of silver and auric acid is to be boiled in nitric acid, and then treated with aqua regia, which dissolves the gold, and leaves the chloride of silver. The gold solution diluted is then boiled with excess of oxalic acid.

### The Supposed New Gunpowder.

To the Editor of the CHEMICAL NEWS.

SIR,—There is a great noise being made just now by the correspondence going on in the various naval and military journals about a celebrated discovery by a German chemist named Dr. Erhardt of a new gunpowder, for which a patent has been applied for.

My suspicion being excited, I waited for further information thereon, but the specification given in the *Times* of the 6th shows that it is none other than my own invention of 1857 revived, and which I had previously submitted to our Government, and at length published in the CHEMICAL NEWS for August 16, 1862, composed of chlorate

\* We shall give it next week.



of potash and powdered galls, which was proposed as a safety powder, to be kept in a separate incombustible state till wanted. So much for this so-called new German discovery. Is it not sickening to scientific men to see their inventions so appropriated by others? Being published, it cannot be patented. I am, &c.

JOHN HORSLEY, F.C.S.

The Laboratory, Police-station, Cheltenham, March 13.

#### *On the Carbonate of Magnesium and Ammonium.*

To the Editor of the CHEMICAL NEWS.

SIR,—Allow me to correct a slight error occurring in Mr. E. Sonstadt's paper, "On a New Reagent for the Separation of Calcium from Magnesium," which appeared in the CHEMICAL NEWS of the 3rd inst. The "special notice" on the carbonate of ammonium and magnesium to which Mr. Sonstadt refers in the following passage was communicated by myself to the Chemical Society:—

"When, in the ordinary course of qualitative analysis, carbonate of ammonium is used to separate calcium from magnesium, unless the former is present in notable proportion to the latter, a very insoluble double carbonate of magnesium and ammonium always accompanies the carbonate of calcium, if this is allowed sufficient time to form. If much magnesium and no calcium is present, the magnesium precipitate still falls after awhile. . . . This fact is cursorily mentioned by Fresenius, more fully by Gmelin, and has recently been made the subject of a special notice by Dr. Dyer."

I take the present opportunity to draw attention to the statements which still occur in text-books of recent issue, to the effect that carbonate of ammonium does not precipitate magnesium salts in the presence of chloride of ammonium, in spite of the assertions to the contrary in the last edition of H. Rose's "Analyse Qualitative," the last English edition of Fresenius' "Qualitative Analysis," and in my own paper. Indeed, this error, so easily tested by experiment, is emphasised by italics in the last edition of Fownes' "Manual." The precipitation is remarkably near completeness, for phosphate of sodium gives only a faint precipitate in the mother liquor. It commences in a few minutes, varying according to the strength of the solution and the extent to which agitation is practised.

In my communication I neglected to mention the influence of a large excess of ammonia solution upon this precipitation: I may now state that the strongest solution added in great excess serves only to quicken it.

Carbonate of magnesium and ammonium is prepared with the greatest ease in large quantity by adding a solution of carbonate of ammonium to a mixed solution of sulphate of magnesium, chloride of ammonium, and ammonia, as described in my paper, yet no mention is made of this salt in the recent edition of one of the leading English text-books, although the carbonate of potassium and magnesium, instable and somewhat difficult to prepare as it is, receives due notice in it.

This interesting salt is also a ready source of normal carbonate of magnesium in any quantity, for the double salt requires simply to be digested for a few minutes with water to yield it in a dense and crystalline form, pure if freed from the mother liquor by washing. It is, therefore, a much more eligible source of carbonate of magnesium than the solution of *magnesia alba* in carbonic acid water, or the mixture of sulphate of magnesium and carbonate of sodium enclosed in sealed tubes.—I am, &c.

EDWARD DIVERS, M.D.,

Prof. Mat. Med., Qu. Coll., Birmingham.

5, Mildmay Park Terrace, Stoke Newington, N., March 13.

**Royal Institution.**—This evening, Friday, March 24, Professor Westmacott, R.A., F.R.S., "How Works of Art should be Looked at."

## MISCELLANEOUS.

**Chemical Society.**—The anniversary meeting of this Society will take place on Thursday evening next, at 8 o'clock.

**Titanuretted Hydrogen.**—In a letter to the Parisian journal *Cosmos*, Dr. Phipson announces that he believes he has formed titanuretted hydrogen by the action of magnesium on titanous acid. The author promises shortly a detailed account of the results of the action of magnesium on titanous, tungstic, molybdic, and other metallic acids.

**Dyeing of Mixed Tissues.**—Prepare a bath of salt of iron from 1° to 8°, acetate of iron for instance, heat it to from 60° to 63°, soak the material in it for two hours, which next rinse in running water, and it is then ready for dyeing. Prepare the dye bath with the same salt of iron with the addition of extract of logwood, maintain the temperature at 40° or 50°, bathe the material in it for fifteen or twenty minutes, and then boil it for an hour. Remove the pieces, add a small quantity of salt to the bath, boil for another hour, and the dyeing will be complete. This process dyes black mixed animal and vegetable fibres, either fleece, carded, combed, spun, or woven. By varying the mordant and the extracts different colours are obtained. It is especially applicable to the dyeing of *renaissance* tissues, obtained by unravelling scraps of wool mixed with cotton. Scraps of wool, which were formerly used as manure or in the manufacture of Prussian blue, are now collected for unravelling. In the inferior scraps the wool may be separated from the cotton and the cotton from the wool. The action of hydrochloric acid disaggregates the cotton, and leaves the wool (not exactly intact, as it becomes harsh and refuses to felt). The action of soda or sulphide of sodium dissolves the wool and leaves the cotton, which may be used in paper-making, while the dissolved wool may be used for manure.—*M. Grison, Bulletin de la Société Chimique.*

## ANSWERS TO CORRESPONDENTS.

\*.\* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 12s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI, commenced on January 6, 1865, and will be complete in 26 numbers.

Mr. Newland's communication is unavoidably postponed until next week.

*A Subscriber.*—If your object is to clarify the solution, mix a little white of egg, and boil; or you might filter the fluid while hot.

*W. G. (Cowlairs.)*—We know of no work treating of either subject. The second is a matter for individual experiments. The oil could, of course, be separated by the addition of an acid and boiling.

*M. W. writes:*—"I have read with interest Dr. Adriani's papers on cotton-seed oil and its purification, and notice Mr. Bloeky's letter in your number of 10th inst. Perhaps Mr. Bloeky will explain his mode of purifying the oil, if it is not a trade secret."

*C. R. writes:*—"Can your correspondents explain whether truth is in the common notion that strong sunshine checks fires in grates; and if so, by what force?"—It is an optical delusion, dependent upon the much greater brilliancy of sun-light over fire light.

*Spectrum Analyst.*—The spectroscope is the natural development of the discoveries of Newton, Wollaston, Fraunhofer, and others. It would take an entire CHEMICAL NEWS to answer the rest of our correspondent's questions, solutions to which he can easily obtain by reading our back numbers.

*Al Chemicus.*—Reflected light is always more or less polarised, but apart from that there is no means of distinguishing it from transmitted light. The Royal Society fund is not intended to aid amateur experimenters, but to relieve persons of known attainments in distress. If you communicate matters of special interest to the Society, you may get a grant towards further investigations.



## THE BILLS FOR REGULATING THE QUALIFICATIONS OF CHEMISTS AND DRUGGISTS.

WE feel bound to say that a fuller acquaintance with the bill of the United Society does not increase our respect for the measure. We have said that it seemed to provide cumbrous machinery for effecting simple objects, but on looking more closely into the matter the machinery seems shadowy rather than cumbrous, while some of the provisions of the bill—clause 16, for example—are decidedly unjust. The United Society itself appears to be yet in the nebulous state; the bill indicates gaseity in the body from which it emanates, and which is at most resolvable into but one discrete (not *discreet*) point. The condensation of this vapour is to be effected at a public meeting of the whole trade, convened by advertisement, and presided over by a Government Commissioner, who may decline to ratify, and so stultify, the whole proceedings. This alone, we take it, is sufficient to ensure the defeat of the bill. The only chance the Society had was exhibiting itself in a position to commence operations at any moment, ready provided with an executive capable of carrying the provisions of the bill into effect. Instead of that, all has to be evolved from the chaos of a public meeting, to which all chemists from John O'Groats to the Land's end are to be invited by advertisement. We do not believe that any such meeting would fairly represent the trade, and should be very sorry to see the experiment tried.

Regarding it as impossible that both bills can be passed, we need not stop to point out the inconvenience and confusion which would ensue from such a result. Any one who has taken an interest in medical politics, must have seen the evils that have resulted from a multiplicity of examining and licensing bodies. Our own views on the subject of licenses are tolerably decided, and we may briefly state them. We believe that the power of licensing to practise in any profession or trade should reside solely in the State, which might fairly make the licenses a means of direct taxation. To obtain the license a minimum examination should be passed. If any one, say a chemist and druggist, should wish for some scientific distinction, he might go the London University, and become a Bachelor of Science; or if he belonged to the medical profession, he might go to any other body that confers a title, if he could find one whose title he could feel proud of possessing. But in the light of past events, such a scheme seems Utopian, and we must accept things as they are. Under these circumstances, we would press the acceptance of the Bill of the Pharmaceutical Society, subject to the amendments we mentioned last week. The first of these is that all registered chemists and druggists be admitted to the full privileges of Pharmaceutical Chemists. There is that unfortunate difficulty of the Juries' Act to which we must allude. We never supported that measure when it was before Parliament. It was carried upon false pretences. The fact is that the majority of the members of the Pharmaceutical Society are in a position to employ assistants as intelligent and trustworthy as themselves, and no one is likely to suffer from their absence on a jury. It is the unhappy chemist and druggist, whose means will only allow

him to employ an errand boy—gifted possibly with the perverted understanding described by Mr. Dickens—it is this man's business that suffers by a week's absence of the proprietor at the assizes twenty miles away, and it is in his establishment, if in any, that life is jeopardised. And such a man gets no relief under the Bill, although much more entitled to it than a London pharmaceutical chemist with half a dozen competent assistants behind his counter. Nor is the public protected in the only quarter in which it needs protection. We see no way out of this difficulty but in recommending Sir George Grey to bring in a short Bill to render chemists and druggists or pharmaceutical chemists—we use the terms as convertible—liable to serve as jurymen in special cases, such as patent disputes, poison trials, and coroners' inquests, in which the knowledge they are supposed to possess might assist in the administration of justice.

Passing from that, however, we again urge that the *whole* trade in drugs and poisons should be under control. Some weak objections to this might be easily overcome by drawing up a schedule of simple domestic medicines which village shopkeepers might be allowed to retail with perfect safety, while it would prevent them from dealing in active and dangerous substances.

We intended to offer some remarks on that part of the Bill of the United Society which relates to the examination of chemists and druggists, but the limited space we can devote to discussions of this kind compels us to defer these for the present.

## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

### On Cobaltic Acid.\*

THE existence of cobaltic acid, which has long been suspected, seems to be proved by M. Winkler's experiments. According to him, by boiling different cobalt products, but more especially the metal in powder, with a concentrated solution of caustic potash, an intensely blue liquid is obtained, containing cobaltate of potash.

The proper proportions seem to be one part of metal in a spongy state (produced by the reduction of protoxide by means of hydrogen or starch), one part of caustic potash, and three of water; the boiling is continued until the dark blue colour is produced, after which the mixture is filtered through asbestos.

Cobaltate of potash is not very stable; it cannot be evaporated to dryness; its solution decomposes spontaneously, and the more rapidly the more it is diluted; acids precipitate from it hydrated protoxide with disengagement of oxygen, a part of which dissolves in the water, forming binoxide of hydrogen, hydrochloric acid is decomposed, and its chlorine set at liberty. Sulphurous acid is transformed into sulphuric acid, which combines with the protoxide of cobalt. By estimating the cobalt and determining the quantity of sulphuric acid formed in a given volume of cobaltate of potash, the author has ascertained the composition of cobaltic acid; he represented it in his first paper by  $\text{CoO}_5$ , and afterwards by  $\text{CoO}_3$ . It would be interesting to compare this compound with that obtained by M. Schwartzberg by fusing oxide of cobalt with potash in contact with the air.†

\* *Journal für Praktische Chemie*, xc., 213.

† *Ann. de Chimie et de Physique*, l.



*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

## PART I.

## EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

SECTION II.—*New System of Atomic Weights.*

(Continued from page 135.)

**1. The new atomic weights are identical, with about three exceptions, with those deduced from Dulong and Petit's law.** It follows from M. Regnault's researches that the anomalies observed in this law (pointed out at p. 109) were owing to inaccurate determinations of the specific heat of many bodies. But, on the other hand, M. Regnault has found that this law does not yield results of that rigorous accuracy which it was at first supposed to do, as may be seen by the following table:—

Names of solid elements.	Specific heats.	Atomic weights.	Product of specific heat multiplied by atomic weight.
Sulphur (between 0° and 100°)	0.2026	32	6.483
Selenium . . . . .	0.0762	79.5	6.058
Tellurium . . . . .	0.0474	129	6.115
Bromine (between -78° and -20°)	0.08432	80	6.746
Iodine (between 0° and 100°)	0.05412	127	6.873
Phosphorus (between 10° and 30°)	0.1887	31	5.850
Arsenic . . . . .	0.08140	75	6.095
Carbon { graphite . . . . .	0.200	12	2.400
{ diamond . . . . .	0.147	12	1.764
Crystallised boron . . . . .	0.250	11	2.750
Silicium (mean)* . . . . .	0.176	28	4.928
Potassium . . . . .	0.1695	39.1	6.500
Sodium (between -34° and +7°)	0.2934	23	6.748
Lithium . . . . .	0.9408	7	6.586
Thallium . . . . .	0.03355	204	6.844
Magnesium . . . . .	0.2499	24	5.998
Aluminium . . . . .	0.2143	27	5.786
Manganese . . . . .	0.1217	55	6.693
Iron . . . . .	0.5138	56	6.115
Zinc . . . . .	0.09555	65.2	6.230
Cadmium . . . . .	0.05669	112	6.349
Cobalt . . . . .	0.1068	59	6.301
Nickel . . . . .	0.1089†	59	6.424
Tungsten . . . . .	0.0334	184	6.146
Molybdenum . . . . .	0.0722	96	6.931
Lead . . . . .	0.0314	207	6.450
Bismuth . . . . .	0.0308	210	6.468
Copper . . . . .	0.09515	63.5	6.042
Antimony . . . . .	0.05077	122	6.118
Tin . . . . .	0.05623	118	6.635
Mercury (between -77° 5' & -44°)	0.03247	200	6.494
Silver . . . . .	0.05701	108	6.157
Gold . . . . .	0.0324	197	6.383
Platinum . . . . .	0.03293	197.5	6.487
Palladium . . . . .	0.0593	106.5	6.315
Osmium . . . . .	0.03063	199.2	6.101
Rhodium . . . . .	0.05803	104.4	6.058
Iridium . . . . .	0.03259	198	6.453

It is seen that the only exceptions to Dulong and Petit's law are carbon, silicium, and boron. This circumstance is doubtless due to some peculiarity in the molecular constitution of these bodies in the free state, and which is connected with the many allotropic states which they can assume. Let us take carbon as an instance. The different modifications of this element possess different specific heats, and consequently dif-

ferent thermal equivalents; and whilst in the case of other elements the thermal equivalents are identical with the atomic weights obtained by chemical means, this is not the case with carbon. It is also to be remarked that there exists no simple relation between the thermal equivalents of carbon and its atomic weight, 12. In the following table these thermal equivalents have been obtained by dividing the constant product 6.4 † by the specific heats:—

	Specific heats.	Thermal equivalents.	Atomic weight of carbon.
Animal charcoal . . . . .	0.26085	24.5	
Graphite . . . . .	0.200	32.0	12
Diamond . . . . .	0.147	43.5	

Experience, moreover, has shown that carbon in combination possesses a different specific heat from that which it has in its different modifications. If, therefore, Dulong and Petit's law were rigorously exact, one ought to say that, as carbon possesses different specific heats according as it is free or combined, and according to its different allotropic states, so also does it possess different atomic weights, and these atomic weights are identical with the thermal equivalents given above. This conclusion appears strange at first sight. It is, however, strengthened by the interesting facts which Mr. Brodie § has discovered relative to the oxidation of graphite. In treating this body with nitric acid and chlorate of potash he obtained a certain acid, graphitic acid, in which he proves the existence not of carbon, but of graphite itself. He represents the composition of this acid by the formula  $\text{Gr}_4\text{H}_4\text{O}_5$ , in which the graphite possesses the atomic weight 33, which approaches closely to the thermal equivalent 32 indicated above.

Thus, chemical facts and theoretical considerations respecting specific heat lead us to look upon free carbon as forming in its various states aggregations of matter differing from the chemical atom which exists in the combinations of this body. These aggregations which are governed by heat differ in relative weights according to the allotropic states of carbon. They represent the physical atoms of free carbon, and for graphite at least it would appear that these atoms are capable of forming special combinations.

Such is the interpretation which the facts at present known allow us to give to the anomalies which are presented by the specific heats of carbon. There is nothing to prevent the same interpretation being extended to boron and silicium, so similar to carbon by the number of their allotropic states.

As to the other elements, it is seen by the preceding table that the product of their specific heats by their atomic weights are practically equal, which is the same thing as saying that the specific heats of their atoms are sensibly identical. They are not absolutely the same, to judge by the results of experiment; but the differences which are shown in this respect may be due to certain disturbing causes.

In reference to this subject, it must, in the first place, be considered that the atomic weights of some elements are not determined with all the accuracy which is desirable, and the same, perhaps, may be said of the specific heats of some simple bodies which it is difficult to isolate in a state of perfect purity. On the other hand, as M. Regnault has observed, || the determination of the specific heats of solid bodies involves some uncertainty, "for it includes many other elements which have not

\* Regnault, *Annales de Chimie et de Physique*, 3rd series, lxiii. 24.† Mean of M. Regnault's determinations, *Annales de Chimie et de Physique*, 3rd series, lxiii. 23.

‡ Mean of the product of atomic weights by specific heats.

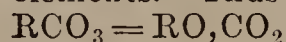
§ *Philosophical Transactions*, 1859, p. 249.|| *Annales de Chimie et de Physique*, 3rd series, xxvi., 262.



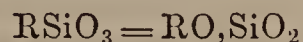
yet been successfully separated, especially the latent heat of dilatation, and a portion of the latent heat of fusion which bodies successively absorb as they soften, frequently long before the temperature which is regarded as their fusing point."

Similar disturbing influences naturally interfere with the specific heat of compound bodies. It has been observed that in general equivalent quantities of substances which possess a similar atomic composition have also the same specific heat; the product of the specific heat of these substances by their atomic weights are sensibly equal; and if this product is called *atomic heat* we may say with Hermann Kopp "that these bodies possess the same atomic heat."¶

This latter physicist has, however, pointed out several exceptions to this law. Whether they be due to the above-named disturbing influences, or to some other cause, it is not less true that the law in question is worth attention, for it is verified in the case of many groups of analogous bodies, provided the new atomic weights are adopted for the elements. Thus the carbonates\*\*



and the silicates—



have the same atomic heat provided the atomic weight 12 is taken for carbon, and 28 for silicium.

M. Regnault observed some time ago that the chlorides of tin, titanium, and silicium possessed sensibly the same atomic heat, provided the composition of chloride of silicium were expressed by the formula  $\text{SiCl}_4$ , and the atomic weight of silicium were consequently taken at 28††. The following figures demonstrate this:

	Specific heat.	Molecular weight.	Product.
Chloride of tin . . .	0.1413	260	36.7
Chloride of titanium . .	0.1813	192	84.8
Chloride of silicium . .	0.1907	170	32.4

It is thus that theoretical considerations respecting the specific heat of some compounds of carbon and silicium justify the atomic weights assigned to these elements, which, in the free state, form exceptions to Dulong and Petit's law.

Upon comparing the atomic heats of a large number of compound bodies, it is observed that they are formed of the sum of the atomic heats of their elements. Indeed, the product (CA) of the specific heat multiplied by the atomic (molecular) weight is practically equal to  $n \times 6.4$ ;  $n$  being the number of elementary atoms contained in a compound having the specific heat C, and the molecular weight A; and 6.4 being the mean atomic heat of simple bodies as derived from the table on page 134. We thus get the formula††  $n \times 6.4 = \text{CA}$ .

In some cases this relation may serve for the indirect verification of an atomic weight. As an example:—Is the atomic weight of mercury 100 or 200?

In the former case if we represent 100 of mercury by the symbol Hg, the mercurous and mercuric chlorides, bromides, and iodides contain—

Mercurous compounds.	Mercuric compounds.
$\text{Hg}_2\text{Cl}$	$\text{HgCl}$
$\text{Hg}_2\text{Br}$	$\text{HgBr}$
$\text{Hg}_2\text{I}$	$\text{HgI}$

¶ M. Regnault has put this law in the following manner:—"The specific heats of compound bodies having the same chemical formula are to one another in the inverse ratio of their equivalents."—*Annales de Chimie et de Physique*, 3rd series, xxvi., 264.

\*\* It is the same according to Hermann Kopp in the case of nitrates and chlorates  $\text{RN}\text{O}_3$  and  $\text{RClO}_3$ , perchlorates and permanganates  $\text{RCIO}_4$  and  $\text{RMnO}_4$ , sulphates and chromates  $\text{RSeO}_4$  and  $\text{RCrO}_4$ .

†† *Annales de Chimie et de Physique*, 3rd series, ix., 341.

‡‡ Hermann Kopp, *Comptes Rendus*, lvi. 1254

In the latter case, if we represent 200 of mercury by the barred symbol  $\text{Hg}, \S\S$  they become—

Mercurous compounds.	Mercuric compounds.
$\text{Hg}_2\text{Cl}_2$	$\text{HgCl}_2$
$\text{Hg}_2\text{Br}_2$	$\text{HgBr}_2$
$\text{Hg}_2\text{I}_2$	$\text{HgI}_2$

Judging from the specific heats of these compounds, it is the second of the formulæ which express the atomic composition of these chlorides; for in this case we have  $n = 4$  for the mercurous compounds, and  $n = 3$  for the mercuric compounds; and the atomic heats, which can be calculated according to the preceding formula, are practically the same as those directly deduced from experimental data.

Formulae.	Specific heats.	Molecular weights.	Product of molecular weight by specific heat.	Calculated atomic heats.
		$\text{Hg}=200$	Experimental atomic heats.	$n \times 6.4$ .
$\text{Hg Cl}_2$ .	0.0689	271	18.67	19.2
$\text{Hg I}_2$ .	0.0420	454	19.06	19.2
$\text{Hg}_2\text{Cl}_2$ .	0.05205	475	24.51	25.6
$\text{Hg}_2\text{I}_2$ .	0.0385	654	25.83	25.9

It must be mentioned that this very simple relation between the atomic heat of a compound and the atomic heats of the elements which it contains does not hold good, according to M. Hermann Kopp, for all compounds. It is accurate in the case of chlorides, bromides, and iodides. It has just been shown, for instance, that the iodine and the mercury possess, in the form of iodide of mercury, the same atomic heat which they have in the free state. But this is not always the case. The preceding rule, therefore, will not bear general application.

(To be continued.)

### On the Separation of Manganese from Cobalt, Nickel, and Zinc, by WOLCOTT GIBBS, M.D.

SCHIEL'S method of separating manganese from the alkaline earths by adding acetate of sodium to the mixed solutions, heating the liquid gently, and then passing chlorine through it, so as to convert the manganese into a hydrate of the sesquioxide, is better than that formerly given by myself, in which peroxide of lead is used as the oxidising agent. With respect to Schiel's method, however, it must be remarked that it cannot be employed to separate manganese from nickel or cobalt, because both of these metals are converted into higher oxides under the same circumstances. Nickel may, as Popp has recently shown, be completely precipitated as a deep blue hyperoxide; while, as I have myself observed, cobalt is also oxidised, though not precipitated, unless the solution is boiled with an alkaline carbonate. In separating manganese from zinc, calcium, or magnesium, I have repeatedly found that a second treatment is necessary in order to obtain a perfect separation. This second treatment may be neglected in separating manganese from calcium and magnesium, but not in separating it from zinc, although the addition of a few drops of free acetic acid renders the process more exact.

§§ The barred symbols represent atomic weights which are double the equivalents, as explained further on.

||| Or  $\text{HgCl}$ ,  $\text{HgBr}$ ,  $\text{HgI}$ . These are the latest formulæ adopted by M. Cannizzaro. We prefer the doubled formulæ, for reasons to be given hereafter. It is evident, besides, that if arguments based on the specific heat of the compound bodies in question are allowed to decide in reference to the atomic weight of mercury, they throw no light whatever on the question as to doubling or not the formulæ of mercurous compounds. If they are doubled, as we have written them, each side of the equation—

$$n \times 6.4 = \text{C}, \text{A}$$

must be multiplied by 2.



Though the method of separating manganese from other bases by means of peroxide of lead, which I formerly proposed, will hardly be used in future, now that we are in possession of more convenient processes, it will still be of some interest to chemists to know the precise nature of the insoluble black compound which is formed when peroxide of lead,  $\text{PbO}_2$ , is digested or boiled with an excess of a solution of chloride or nitrate of manganese and afterwards thoroughly washed. An analysis of this body, made some years since in my laboratory by my lamented friend and former pupil, Mr. Theodore Parkman, gave the following results:—

		Anhydrous.	Theory.
Manganese	. 35.10	37.96	37.53
Lead	. 32.49	35.13	35.26
Oxygen	. 24.87	26.90	27.20
Water	. 7.52	—	—
	100.00	100.00	100.00

Neglecting the water, which may have been, in part at least, mechanically combined, and which amounts to between three and four equivalents, we have the formula,  $\text{MnO}_2 + 4\text{PbO}_2$ , as the simplest expression of the result of analysis.

A simple and perfectly satisfactory process for separating manganese from cobalt, nickel, and zinc, is the following:—To the neutral or nearly neutral solution of the chlorides, acetate of sodium is to be added in excess together with a few drops of free acetic acid. The solution is then to be boiled, and a rapid current of sulphydric acid gas passed through it while boiling, and continued for half-an-hour. Every trace of cobalt, nickel, or zinc, is precipitated in the form of sulphide, while the whole of the manganese remains in solution. The precipitate is to be thrown on a ribbed filter and quickly washed with cold water saturated with sulphydric acid gas. It is easily washed, and though the sulphides of cobalt and nickel precipitated in this manner are far more easily oxidised than when precipitated by boiling sulphide of sodium from boiling solutions, they will be found to present no difficulty as regards oxidation upon the filter. Manganese may then be determined in the filtrate by boiling with chlorhydric acid and precipitating in the usual manner with carbonate of sodium. The mixed sulphides upon the filter—supposing for the sake of generality that all three are present—are to be dissolved in chlorhydric acid, and the metals converted into double cyanides by means of an excess of cyanide of potassium, after which the zinc may be precipitated by means of sulphide of sodium, as recommended by Wöhler.

When perfectly pure cyanide of potassium is not at hand, the following process will be found particularly convenient:—Acetate of sodium is to be added to the solution of the mixed chlorides, after which the vapour of cyanhydric acid, generated in a flask from sulphuric acid and ferrocyanide of potassium, is to be passed directly into the solution. Cyanide of zinc is immediately precipitated more or less completely as a perfectly white powder. A solution of sulphide of sodium is then to be added as long as a precipitate is formed, after which the sulphide of zinc is to be separated by filtration. Cobalt and nickel remain in solution as double cyanides. The same process may be used to separate manganese from cobalt and nickel, sulphide of sodium throwing down under these circumstances a pure flesh red precipitate. It is easy to see that zinc and manganese together may be separated from cobalt and nickel by the same process and at one operation. No cyanide of manganese appears to be formed when cyan-

hydric acid is passed into a solution containing a salt of manganese, acetic acid, and acetate of sodium.

I have stated in a former paper that the sulphides of nickel and cobalt are thrown down from boiling solutions by a boiling solution of sulphide of sodium in an insoluble form, so that in fact even strong chlorhydric acid scarcely exerts upon them an appreciable action. This process has been applied to the separation of cobalt and nickel from zinc and manganese by my excellent assistant, Mr. Maurice Perkins, and gives results which are very satisfactory, especially for qualitative purposes, the sulphides of manganese and zinc precipitated under the same circumstances being readily soluble, even in dilute acid. The process is now substituted in this laboratory for that given in most of the recent works on qualitative analysis, and has been repeatedly tested with satisfactory results.—*American Journal of Science and Art*, January, 1865.

#### *On the Separation of Uranium from Zinc, Cobalt, and Nickel, by WOLCOTT GIBBS, M.D.*

THE method which I have already given for the separation of manganese from cobalt, zinc, and nickel, by precipitating the sulphide of the three last-named metals, by means of sulphydric acid gas from a boiling solution of the acetates, may be also used, according to the carefully conducted experiments of Mr. Perkins for the separation of uranium from the same metals. The process is in all respects the same, and requires, therefore, no further description. It will be found much simpler and more convenient than that described by Rose, by means of carbonate of barium.—*Amer. Journ. of Science and Art*, January, 1865.

#### *On the Action of Caustic Soda on Ethylic and Methylic Alcohol,\* by Mr. A. MYLIUS.*

SCHUNCK's experiments concerning the action on indigo blue of acetate of soda, caustic soda, and alcohol first led me to examine in his laboratory the influence of caustic soda on alcohol and methylic alcohol in sealed tubes.

I obtained in each case a resin, differing considerably from the resinous body which is obtained by boiling an alcoholic solution of caustic soda for some time at the ordinary pressure and then precipitating by an acid. This so-called aldehyde resin has a different composition according to the proportion of acid employed in its preparation, so that I think it not improbable that it may be composed of two resins. Its colour is dark brown, and it is soluble in alkali.

On heating the same solution for some time in sealed tubes, so as to obtain increased pressure, there is formed by the influence of the alkali a resin which is insoluble in alkali. In a short time the liquid becomes red, and on the addition of water the resin is precipitated, the liquid becoming colourless. This takes place also when methylic alcohol is employed.

The resins thus formed are of a red colour.

After filtration and washing with water the resin was dissolved in alcohol, and the residue, after evaporation, dried at  $100^\circ \text{C}$ . When cold these resins are hard and brittle, but they have no crystalline structure. They are soluble in alcohol and ether. The resin formed from methylic alcohol melts at  $59^\circ \text{C}$ ., the other at  $65^\circ \text{C}$ . The odour of the former is like that of cedar wood, while that of the latter more resembles the smell of oranges. In general there is a great resemblance between these

\* Read before the Lit. and Phil. Society of Manchester.



resins and the natural resins, such as copal, &c. In employing methylic alcohol the formation of the resin takes place much more easily, and a greater quantity of product is obtained. I tried in various ways to decolorise the resins, but did not succeed.

Through the alkaline liquid filtered from the resin a current of carbonic acid was passed, then it was evaporated, and the saline residue having been treated with sulphuric acid in excess, the liquid was distilled. The distillate was acid; silver solution was reduced by it in an instant, so that there was little doubt of the presence of formic acid (but the peculiar smell of propionic acid could not be perceived).

From the analysis it must be inferred that the two resins have the same composition; but still, as their properties are not identical, I think they are only isomeric.

The analysis afforded the following results:—

1. 0.1860 grm. (methylic alc.) gave 0.5080 grm. carbonic acid and 0.1550 grm. water.

2. 0.2465 grm. (methylic alc.) gave 0.6795 grm. carbonic acid and 0.1965 grm. water.

3. 0.2090 grm. (ethylic alc.) gave 0.5745 grm. carbonic acid and 0.1590 grm. water.

4. 0.1805 grm. (ethylic alc.) gave 0.4960 grm. carbonic acid and 0.1330 grm. water.

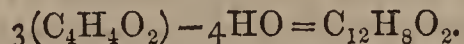
These numbers lead to the following composition:—

	I.	II.	III.	IV.
C	74.50	75.10	74.97	74.95
H	8.90	8.85	8.95	8.26
O	16.60	16.05	16.08	16.79
	100.00	100.00	100.00	100.00

The formula  $C_{12}H_8O_2$  with which they correspond requires in 100 parts

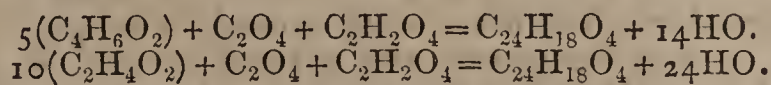
C	75.00
H	8.40
O	16.60
	100.00

The formation of the resins from the alcohols might perhaps be explained by assuming that aldehyde is formed by the oxidation of alcohol, and then by simple loss of water the aldehyde would be converted into resin, since—



But the formic acid in this case would not stand in any relation to the resin, and even the formation of the resin from methylic alcohol could not easily be explained.

If we adopt the formula  $C_{24}H_{18}O_4$ , which requires 74.28 per cent. carbon and 9.10 per cent. hydrogen, we must assume that carbonic and formic acid are taken up by the alcohol, though it is very doubtful whether these acids could separate from a strong base like soda in order to form a neutral resin. The following equations will show what may be imagined to take place in this case:—



Taking two atoms of water from  $C_{12}H_8O_2$ , the formula of benzole  $C_{12}H_6$ , remains. I tried to form this carbon-hydrogen by distilling the resin; the distillate had a strong smell of carboic acid; I acted on it with nitric acid; oxidation took place immediately after the addition of the acid. I now added water, which gave a yellow deposit. I dissolved the latter in alcohol, but on evaporating the alcohol I obtained a resin of the same appearance as the original one. Nitrobenzole had not been formed.

The two resins are of a constant composition, which is proved by the accordance between the third and the fourth analyses, which were made with specimens prepared at different times.

In order to ascertain whether formic or acetic acid takes part in the formation of the resins, I made two other experiments. In one case I added acetate of soda to the caustic soda and alcohol, and in the second case formiate of soda. I analysed the products, and arrived at the following results:—

I. 0.2050 grm. (acetate of soda) gave 0.6190 grm. carbonic acid and 0.1625 grm. water.

II. 0.2255 grm. (acetate of soda) gave 0.6800 grm. carbonic acid and 0.1745 grm. water.

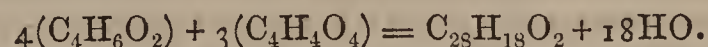
These numbers lead to the following composition:—

	I.	II.
C	82.37	82.24
H	8.80	8.58
O	8.83	9.18
	100.00	100.00

The formula  $C_{28}H_{18}O_2$  requires

C	82.90
H	8.91
O	8.19
	100.00

Assuming that acetic acid is necessary for the formation of this resin, which differs from the products obtained without the addition of the acetate, the following equation will show the way in which the resin has been formed:—



In employing formiate of soda I obtained a resin of the same composition as that produced when no formiate was present.

0.2100 grm. gave 0.5795 grm. carbonic acid and 0.1610 grm. water = 75.25 per cent. carbon and 8.57 per cent hydrogen.

The investigation has therefore led to the discovery of the following facts:—

(1.) The resins which are obtained by the action of caustic soda on ethylic and methylic alcohol in sealed tubes differ from the resin that is formed by the same substances at the ordinary pressure in open vessels.

(2.) Methylic and ethylic alcohol produce resins of the same composition.

(3.) Formic acid is formed.

(4.) When acetate of soda is added the resulting resin differs in its composition.

#### The Preparation of Litmus,\* by M. DE LUYNES.

Two different products are included under the name of litmus, that in sheets and that in cakes. The latter is used as a reagent; with water or alcohol it gives a violet-blue liquid, which becomes light red by contact with acids.

The process for preparing litmus consists in colouring orchil lichens under the influence of air and ammonia, in the presence of a large excess of alkaline carbonate. M. Gelis has tested the exactness of these indications, and has obtained very excellent litmus by treating orchil lichens, mixed with half their weight of carbonate of potash, by ammonia. But whatever the mode of preparation, either carbonate or sulphate of lime is added to the litmus paste, to dry and preserve the colouring



matter, which constitutes but a very small fraction of the total weight of the cakes.

M. Dumas has shown that when orceine becomes coloured under the influence of air and ammonia, it produces only one colouring matter, which is orceine. By modifying the circumstances under which orceine becomes coloured, M. de Luynes has succeeded in preparing a product identical in its properties with litmus. As litmus has not yet been obtained by means of orceine, and as some chemists seem to doubt whether it can be so derived, M. de Luynes has adopted the following process:—He mixed orceine with twenty-five times its weight of crystallised carbonate of soda, and five times its weight of water, with the addition of a weight of liquid ammonia, not more than equal that of the orceine, in imperfectly stopped matrasses. He heated the whole to between  $60^{\circ}$  and  $80^{\circ}$  for four or five hours, taking care to stir it from time to time. The dark violet-blue liquid he diluted with water and saturated with a slight excess of hydrochloric acid, which precipitated the colouring matter; this latter washed and dried is pure litmus.

Litmus thus prepared is in the form of small irregular masses with the variegated metallic reflections common to most colouring matters. It is very slightly soluble in cold water, to which it imparts a wine-coloured tinge, which by contact with acid turns to the colour of onion skin, and with alkalis to violet blue. In alcohol also, which it colours yellow. Concentrated sulphuric acid dissolves it, taking a very rich violet-blue colour, which becomes light red on the addition of a large quantity of water.

The alcoholic solution, diluted with water, constitutes a reagent extremely sensitive to the slightest trace of alkaline substance. By adding a little potash to it, a blue liquid is obtained, which in contact with acids, sulphuretted hydrogen, and other compounds behaves in the same way as ordinary litmus solution.

Dry litmus, heated in a tube, gives an abundant deposit of carbon, and disengages ammonia.

The preparation of ordinary litmus solution requires some time; it does not keep long without altering, and to render it sensitive the excess of alkali it contains must be saturated. M. de Luynes' product keeps without altering in the dry state; the cold solution can be very rapidly prepared, and may be immediately employed in any determinations by standard solutions.

## TECHNICAL CHEMISTRY.

### *Preparation of Sulphate of Ammonia.\**

MM. MARGUERITTE, Lalouet, de Sourdeval, and Worms, of Romilly, have, with the co-operation of the able director of the Compagnie Richer, established at Bondy a large factory of sulphate of ammonia, producing daily from 7000 to 8000 kilogs. The raw material is the liquor of the Bondy basins, which is merely the liquor of cesspools left to stand for a time sufficient to exhaust the fermentation, and transform the urea into carbonate of ammonia, the solution of which is decanted. Ammonia exists in these liquids in the state of sesquicarbonate or bicarbonate.

The distilled ammoniacal liquid, which is perfectly limpid, marks  $18^{\circ}$  on Baume's areometer, and even more than that, for the solid carbonate may be obtained.

Ammoniacal sulphate and hydrochlorate are prepared

by the direct action of the ammoniacal liquid on sulphuric acid at  $55^{\circ}$ , or hydrochloric acid at  $22^{\circ}$ . The evaporated salts are sublimed in the ordinary manner on hearths heated by the waste heat.

The manufacture of ammoniacal salts will before long absorb all the liquids daily carried to Bondy; and if, as is to be hoped, some means is found to accelerate the production of powdered night-soil, the manufactory of Bondy, which is very favourably situated, will become no greater nuisance than others of its kind.

M. Margueritte is now engaged on a new improvement in the manufacture of sulphate of ammonia, in which he substitutes gypsum for sulphuric acid.

Carbonate of ammonia, by double decomposition, produces carbonate of lime and sulphate of ammonia. This reaction is well known, but what is new is that this reaction is singularly facilitated by the addition of a small quantity of chloride of calcium.

## PHARMACY, TOXICOLOGY, &c.

### *New Process for Making Fluid Extracts,* by Mr. SPENCER THOMAS.

THIS invention relates to an improved process for producing that class of extracts which are made so that a certain amount of liquid shall represent, pound by pound, medically the same quantity of crude drug, and which are generally obtained by extracting with a large excess of liquid and evaporating down to the desired strength. The disadvantages of the old process are well known to every chemist. The menstrua used for making extracts are usually of an etherial or volatile nature—such as alcohol of various strength—and their strength changes by evaporation as they are exposed for a longer or shorter period to the open atmosphere. If such menstruum is poured over a certain drug, it dissolves and extracts more or less of the soluble parts of the same according to its strength; but if the same liquid has to be poured repeatedly over the same drug, it loses its strength alcoholically, and some of those portions first dissolved are precipitated, and an imperfect extract is the result. The value of the extract being determined by its alcoholic strength when finished, the same or similar reasons render it objectionable to subject the extract, when first obtained, to the evaporating process; for by this process the volatile or spirituous parts of the menstruum are first evaporated, and the weaker liquid is not capable to keep in solution many of those parts of the drug which originally had been dissolved in the extract.

These objections are obviated by my process, which is carried out in the following manner:—I first weigh off a quantity of drug, and the same quantity, or more by weight, of the menstruum or liquid by means of which the extract is to be made. A little more of the menstruum being required, as a little moisture is left in at last pressing. The drug being ground to proper fineness, is then dampened with a small portion of the liquid, and subjected to heavy pressure (say from 800 to 1000 tons), whereby all the liquid, or nearly so, together with such parts of the drug which have dissolved in the same, is expressed. A fresh portion of the liquid is then sprinkled over the drug; a little time being allowed for the liquid to dissolve the soluble parts of the drug, and the same process of pressing repeated until the whole quantity of liquid is used up and the drug is completely exhausted, and the required measure obtained. By this process, an extract is obtained which

\* *Bulletin de la Société Chimique.*



represents, pound by pound, the crude drug. The drug is perfectly extracted, and the menstruum preserves its original strength throughout, so that the same is capable to retain in solution all those parts which are dissolved during the various stages of the process. Furthermore, by my process, the tedious and expensive process of evaporation is dispensed with, and concentrated fluid extracts of any description can be produced cheaper and better than by any process heretofore applied; and as the application of heat is entirely avoided, the preparation does not receive the injury by heat that all such preparations are liable to, if heat is applied to them, no matter how carefully applied or moderate the degree of temperature; and furthermore, the change thereby of strength of solvent is avoided.—*United States' Patent.*

### PHYSICAL SCIENCE.

#### *On the Rate at which Different Liquids Flow through Syphons, by JOHN GALLETTY.*

IN a note of Dr. Ure's, curiously gathered, I believe, by Professor Hunt into his Dictionary of Arts, &c., I have seen it stated that Dr. Ure had tried the rate at which water, sulphuric acid, and rape oil flowed from a platinum vessel through a small platinum syphon. He found these fluids to run off at very different rates, but his exact numbers I cannot at present lay my hands on. The obvious difference in viscosity of the liquids employed seems to have generally been considered sufficient to account for his results. I have found, however, such differences between liquids apparently of about the same degree of limpidity as to lead me to the belief that this method of examining an important property of these fluids is worthy of attention.

As an illustration, I may give the periods required to draw off the liquids named in the following table by a syphon of somewhat narrow quill tubing from a phial holding a little more than 4 oz.; the position of syphon and temperature (60°F.) being the same in all cases:—

Water	74 seconds
Ether	48 "
Bisulph. carbon.	47 "
Whisky, 914 sp. gr.	182 "

Here it will be seen that the differences are somewhat remarkable, and although this was rather a narrow syphon the following results will show that the variations can be as great by employing the tubing in common laboratory use for drawing off the liquids over precipitates, &c. Poiseuille, by employing capillary tubes and somewhat elaborate apparatus, has obtained similar results, and of greater scientific accuracy, of course. Professor Graham has likewise employed capillary tubes in his valuable experiments "On Liquid Transpiration," but the much greater ease with which one can compare the flow of separate liquids by means of a common bottle and syphon may not be without its use, and especially as a guide to interesting results in more elaborate investigations.

The narrower the syphon the greater difference is always found between the rate of efflux of various liquids. I will not give any illustration of this statement, as numerous experiments uniformly confirmed it. The same is the case when the long limb of the syphon approaches the level of the short one. As an indication of the differences to be obtained by more nearly equalising the syphon limbs, I will quote the following experiments:—

The bottle employed held 7300 grs. water, was about

4½ inches deep, syphon a little over ¼th inch bore nearly uniform throughout. In experiments in 1st column long limb 18½ inches longer than short limb. 2nd column 9 ⅛ inches was cut off long limb. 3rd column 9 ⅛ inches more cut off long limb, leaving it only ¼ inch below level of short limb. Temperature in all cases 60°F. On repeating the same experiment twice seldom more than one second difference was obtained.

	Sp. gravity.	First ex- periment. Seconds.	Second ex- periment. Seconds.	Thir ex- periment. Seconds.
Water	1000	49	60	212
Paraffine oil	826	79	—	516
Boghead naphtha	765	49	59	221
Turpentine	876	57	79	334
Whisky	914	85	120	515
Petroleum	812	83	—	549
Turpentine & naphtha half of each.	825	48	64	249

It is curious to observe in the above table that although naphtha runs through the first syphon in a considerably shorter time than turpentine, that a mixture of these liquids in equal proportions flows at a slower rate than even the naphtha by itself. This is not observed as the syphon limbs get more nearly equal. The cause is evidently the greater weight of liquid in the long limb drawing it faster over without the viscosity being increased proportionately.

Experiments were made with wide and narrow syphons adjusted to empty a bottle of water in the same time, to see whether other liquids would also flow through them in an equal time, but the numbers obtained were widely different.

I tried also the effect of using a long and short syphon keeping the ends of the limbs at the same comparative level in both cases. First both limbs were about 19½ inches long, the long limb being kept ⅜ths inch below the level of the other. In the second experiment 10¼ inches was cut equally off both limbs. This syphon was almost uniform in bore, and 19 inches in diameter. The same bottle was employed as in former experiments, holding 7300 grs. water.

	First experiment. Seconds.	Second experiment. Seconds.
Water	179	119
Boghead naphtha	146	103
Turpentine	278	160

The value of this method of examining the flow of liquids, even in this rough way, may be illustrated by the following example. Bottle holding 7300 grs. water, syphon same as in third experiments of second table:—

	Specific gravity.	Seconds.
Paraffine oil	797	286
Petroleum	797	375

These experiments I did not mean for publication, but only as preliminary to a larger and more accurate series I intended making with tubes of as exactly uniform bore as could be obtained and on a considerable variety of liquids, but I must give up the subject, at least for the present, on account of my distance from a situation where these can be conveniently obtained.

Mandal, Norway.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Monday, April 3, at 2 o'clock, General Monthly Meeting. Tuesday and Thursday, April 4 and 6, at 4 o'clock, Charles Newton, Esq., "On Recent Acquisitions to the British Museum." Friday, April 7, at 8 o'clock, Dr. A. W. Hofmann, "On the Atomic Theory." Saturday, April 8, at 3 o'clock, Prof. Marshall, "On the Nervous System."



## PROCEEDINGS OF SOCIETIES.

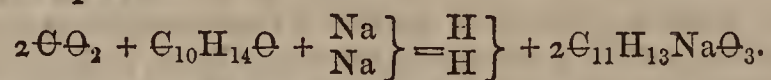
## ACADEMY OF SCIENCES.

March 20, 1865.

A NOTE by M. Meunier "*On the Solution of some Metallic Oxides in Caustic Alkalies in a State of Fusion*" gives an account of some new metallic combinations. Binoxide of mercury dropped into fused potash is quickly dissolved, giving a colourless liquid if the materials are pure, and evolving no gas. How much of the oxide will dissolve the author has not determined; but when the amount of it becomes considerable the temperature rises and oxygen is given off. At the same time the liquid becomes yellow, and acquires an oily consistence. The solution as it cools becomes suddenly coloured, and in the end takes a tint which is regulated by circumstances. Washing with cold water leaves a powder of the same colour as the mass, and the composition of which varies with the colour. A constant product can be obtained by throwing the mercuric oxide on potash not completely fused, stopping the heat as soon as the last portions of oxide disappear, and cooling very gradually. A violet-brown mass is thus formed, to which only sufficient water to dissolve the excess potash must be added; and thus we obtain a violet powder mixed with a greenish powder much lighter, and consequently the two can be separated by simple decantation. The violet powder under the microscope is seen to be made up of fawn-coloured crystals; the green powder is amorphous. Prolonged washing with water decomposes the violet powder, which must therefore be washed with alcohol; and it is better to allow the potash to deliquesce and wash it out with alcohol. The composition of these two combinations of mercuric oxide and potash the author has not yet determined. In a similar way soda yields an orange-brown crystalline powder. Protoxide of bismuth and oxide of cadmium also dissolve in the fused alkalies; but the author does not seem to have determined the exact nature of any of the compounds formed.

In a note "*On the Cementation of Iron by Cast-iron Heated Below its Fusing-point*," M. Cailletet points out a new and perhaps useful method of making steel. By prolonged heating below its fusing-point cast-iron loses carbon; blades of iron, therefore, heated among clean borings of cast-iron become cemented and form excellent steel, according to the author, who has proved that blades in the same furnace, but not in contact with the cast-iron, are not cemented. The cast-iron loses none of its value in this operation, and the process is therefore cheap and practical.

M. Naguet gave an account of "*a New Aromatic Acid*." Cymene  $\text{C}_{10}\text{H}_{14}$  is the highest of the hydrocarbides which until now has furnished an aromatic acid. The author has, however, succeeded in obtaining one from thymol, which contains  $\text{C}_{11}\text{H}_{14}\text{O}_3$  thymicylic acid. He heated thymol with sodium, and at the same time passed a current of dry carbonic acid, imitating Kolbe's method of obtaining salicylic acid from phenol. The reaction is explained by the equation—



Oil of thyme may be employed in place of thymol with the same result. The new acid may be separated by supersaturating the mass with acetic acid, then adding a slight excess of carbonate of ammonia, and separating the aqueous solution from the unattacked thymol. The aqueous solution is then concentrated and acetic acid again added, whereupon the new acid separates, and may be isolated by shaking with ether, in which it is freely soluble. The ethereal solution by spontaneous evaporation yields the acid tolerably pure. Solution in boiling water and one or two recrystallisations from alcohol furnish it quite pure. The author describes the thymicylates of ammonia, silver, zinc, lead, lime, and baryta. The metals

replace but one atom of hydrogen, but the author is still in doubt as to what class the acid belongs.

MM. Harnitz-Harnitzky and Menschutkin presented a note "*On the Compounds of Glycerine with Aldehydes*." With monatomic alcohols aldehydes form *acetals*. Glycols also form combinations with aldehydes. The authors now complete the group by describing compounds of a triatomic alcohol, glycerine, with aldehydes, for which they propose the name *glycerals*. They have, in fact, formed glycerals with acetic, valeric, and benzoic aldehydes. The general method is to heat the two bodies for a long time in a sealed tube.

## NOTICES OF BOOKS.

*Report on the Air of Mines and Confined Places.* By ANGUS SMITH, Ph.D., F.R.S. Part of the Appendix to the Report of the Royal Mines Commission. 1864.

[THIRD NOTICE.]

HAVING seen the diminution in the proportion of oxygen, and the increase of that of carbonic acid, in the air of mines, let us now proceed to notice the special causes of this deterioration, and also the presence of some abnormal ingredients. There are several sources of contamination. In the first place, there is the unavoidable deterioration which the air of a close end suffers from the respiration of the miner himself; there is also the further effects of the combustion of the candles; and, lastly, in the Cornish mines, with which we are now concerned, another source of contamination, namely, the combustion of the gunpowder used in blasting, which, while furnishing noxious gases to the atmosphere, also loads it with solid impurities.

Estimating the cubic capacity of a close end, in which two miners work, at 1200 cubic feet, Dr. Smith calculates that the respiration of two men working for eight hours will introduce into the atmosphere 10.4 cubic feet of carbonic acid, constituting 0.86 of the 1200 feet of air. The combustion of half a pound of candles during the same period will further yield 12.044 cubic feet of carbonic acid, adding 1.02 per cent. to 1200 feet, in which we shall now have 1.883 per cent. of carbonic acid. In the same space three charges of gunpowder of four ounces each will be fired, by which the amount of carbonic acid will be further increased 0.233 per cent., giving us altogether 2.116 per cent. in the atmosphere of the close end. Besides the carbonic acid, we have now other objectionable ingredients, solid as well as gaseous, in the air.

The combustion of gunpowder yields a variety of products, varying somewhat, according to circumstances. Dr. Smith remarks that the theoretical results which should ensue from the combustion are probably never actually accomplished, no mixture of the ingredients being sufficiently intimate to produce them. "The carbon is not wholly burnt during the explosion, the sulphur is not wholly as sulphide of kalium, and the nitre is not wholly robbed of its oxygen." The whole of the gunpowder, in fact, is not exploded when fired as in blasting and under similar conditions, and, therefore, such calculations as these of the results of the explosion must always be more or less incorrect. They are, nevertheless, of great interest, not only to miners, but to military engineers and others. It has been said that in some of our casemated fortifications, and in one of our iron ships the gunners must inevitably be suffocated, in consequence of the vitiation of a close atmosphere by the combustion products of gunpowder.

Dr. Smith's calculation of the composition of 1200 cubic feet of air in which twelve ounces of powder have been fired and two men have breathed will give us some remote idea of the composition of the air between decks in a ship in action, or that of a casemate. We give in



the following table the ingredients by weight thrown into the whole 1200 feet and in one foot :—

	Grains in 1200 c. ft.	Grains in 1 c. ft.
Oxygen . . . . .	139737.7945	114.802599
Nitrogen . . . . .	520470.4	433.818200
Carbonic Acid . . . . .	18525.2	16.008600
Carbonic Oxide . . . . .	49.2	0.041015
Hydrogen . . . . .	1.1088	0.000911
Sulphide of Hydrogen . . . . .	9.239	0.00769
Sulphate of Potash . . . . .	2233.936	1.862865
Carbonate of Potash . . . . .	668.375	0.557316
Hyposulphite of Potash . . . . .	172.668	0.144
Sulphide of Potassium . . . . .	112.592	0.093897
Sulphocyanide of Potassium . . . . .	16.186	0.013476
Nitrate of Potash . . . . .	196.773	0.164075
Carbon . . . . .	38.482	0.032089
Sulphur . . . . .	7.191	0.005989
Sesquicarbonate of Ammonia . . . . .	151.079	0.125779
Solids alone . . . . .		2.999486

But this table does not give the whole of the ingredients of the air in a close end. There is still organic matter, and fine particles of the rock and ore driven about as dust, together with sulphurous acid and arsenic. As regards the last, Dr. Smith observes :—"The pyrites of Cornwall contain a large amount of arsenic, and when struck with a hammer or pick the smell is very strong. It is not a smell which a chemist only may trace, but one well known, and used by the men as a test of the materials. This is a circumstance which may signify good or evil to the miners, most probably evil, but it cannot be entirely avoided, and is counteracted only by draughts of air." "To this long list of impurities," he continues, "must now be added the products of the distillation of tar and of canvass from the burning fuses. These are in amount sufficient to affect the senses, and are of themselves extremely complex."

The table we have given above will have prepared our readers for the remark "that the air issuing from a mine is not an invisible fluid, but contains solid material enough to make it distinctly perceived, if not in all cases, still in cases of mines considered to be well ventilated." Nor will any one be surprised to read that a careful microscopic examination of the tubes in which Dr. Smith collected the air showed that the floating crystallised bodies of the mine air had deposited on the glass. Among the crystals, those of nitrate and sulphate of potash could be most readily distinguished. But, besides the crystalline bodies, there are substances transparent but shapeless, some looking like pieces of quartz, some perhaps looking more like glass. There are also opaque substances which constitute the dust of the rocks, and sometimes portions blacker than others, charcoal of the gunpowder, or perhaps unburnt gunpowder. "Again, there are occasionally filaments of evident organic origin among the complicated material called dust. Portions of ourselves are to be found in it, no doubt; and portions probably of everything existing around us."

And now, how much of this is it to be supposed that a miner inhales in the course of his day's work? Dr. Smith calculates that a man takes into his lungs in the time 111 cubic feet of air, and, allowing for the variations of the atmosphere between the explosions, he supposes that these 111 feet will contain the full amount of solid matter in 30 feet immediately after an explosion. These 30 feet, then, will contain 89.98450 grains of solid matter, and this amount we may suppose a man to inhale with the 111 cubic feet of air. It is impossible to imagine that this cannot be detrimental to a miner's health.

We come next to the organic matter in the air, the consideration of which we postpone until next week.

*The Gas Works of London.* By ZERAH COLBURN, C.E.  
London: E. and F. N. Spon. 1865.

A HISTORY of coal gas, and a description of one of our metropolitan works, would make a most interesting book. To trace the manufacture from its birth in Mr. Murdock's house at Redruth, and its infancy in Mr. Winsor's experiments at the Lyceum Theatre, and the lighting of one side of Pall Mall, to its present gigantic development as represented at the Pancras Station of the Imperial Company, and by the hundreds of miles of mains which now deliver gas over the metropolitan district; and to show the influence of this one manufacture on our moral and social life and commercial progress, would be work which might engage the pen of one who should be at once a chemist, an engineer, and a philosopher—a work in which the future historian of the last half century must find important materials and suggestions. In the absence of such a book Mr. Colburn comes before us in the character of an engineer only, to give us a few dry facts, and (as we shall presently show) a few fictions concerning the manufacture of gas in London to-day. It is only fair to say that he does not pretend to be anything more than an engineer, and therefore the less blame attaches to him for the omissions he leaves and the mistakes into which he falls.

Of the extent of the manufacture of gas in London few persons have any adequate idea. It is estimated, the author informs us, that 1,000,000 tons of coal are carbonised annually, the value of the gas and residual products amounting to 2,000,000*l.*, which is equal to 14*s.* 6*d.* for every man, woman, and child in the metropolis. The labour in the nineteen gas works employs in the winter between 4000 and 5000 men.

Concerning the process of gas-making, and the arrangements for carrying it out, we need say nothing, since every reader of the CHEMICAL NEWS must be more or less intimately acquainted with them. A chemist's business in the matter begins specially with the purification. The illuminating gases leave the hydraulic main contaminated with various gases and vapours, prejudicial in themselves, or generating noxious matters in their combustion. The most obnoxious of these are sulphuretted hydrogen and ammonia and the vapour of bisulphide of carbon. Ammonia is removed by passing the gas through what are called scrubbers,—towers filled with coke or broken crockery, over which trickles a stream of water or dilute acid. The acid employed is usually sulphuric, and the evaporated solution then yields the sulphate of ammonia for the manure and the alum manufacturers. In some instances hydrochloric acid is employed, and what Mr. Colburn calls chloro-hydride of ammonia, or chlorohydride of ammonium, is formed, the uses of which are known to all our readers. In other cases ammonia is distilled from the aqueous solution, and passed into sulphuric acid, by which means a tolerably pure sulphate is obtained in one operation. This utilisation of ammonia has brought much additional profit to the gas-makers, who, not many years ago, sold it for a mere trifle, or paid to have the liquor removed, as some country makers do still. A very important use, however, to which we shall presently allude, has recently been found for it in the gas-works.

The sulphur compounds, are almost profitless, and form also the most objectionable ingredients in gas. Of sulphuretted hydrogen there is but little to complain, since it is almost completely removed in the purification by oxide of iron. The means employed for the removal of bisulphide of carbon are as yet very inefficient. No process hitherto devised is at once practical and thoroughly effective. Mr. Bowditch's method—one of the best yet invented—is open to the objection that the gas is so much heated and expanded that it necessitates additional contrivances for bringing the gas down to the ordinary temperature again. The same objection will apply to Mr. Lewis Thompson's



method, which we recently noticed. Dr. Angus Smith's process, which consists in passing gas through layers of sawdust, saturated with what we may call plumbate of soda, is unfortunately but partially successful.

Recent experiments, however, have shown how one impurity in gas may be employed to remove another. It has been found that simply washing the gas with strong ammoniacal liquor suffices to take out the great bulk of the bisulphide of carbon. This washing is effected as soon as the gas has passed through the condensers. It is then carried into a kind of tower, in its progress up which it encounters a tremendous shower of the ammoniacal liquor. To be very effective, a relatively enormous proportion of the liquor is required—as much as a gallon to a cubic foot of gas has been employed; and with this it has been found that gas which entered the tower with 14 grains of sulphur to 100 cubic feet, left it only with 7 grains. What chemical changes take place in this mode of purification is not yet accurately known; but it seems probable that both the ammonia and the bisulphide undergo some decomposition, which results in the formation of hydrosulphocyanate and hydrosulpho-carbonate of ammonia. This method of purification, however, is still under experiment, and we hope to be able to supply further details.

Mr. Colburn, like every engineer, makes light of the bisulphide of carbon, and strangely enough prints almost *in extenso* the report of Mr. Versmann, which we reviewed (vol. iv., pp. 24—38) at the time of its publication. We need not go into that matter again; it will suffice to mention that, whereas Mr. Versmann found a little over six grains of sulphur in 100 cubic feet of gas in the experiments he made at the works of the Commercial Company, we found over sixty grains in the gas the same Company supplied to their customers. Since the date of those experiments (1861) the quality of London gas has certainly improved in this respect; but the companies in general keep pretty near the Parliamentary maximum of 20 grains in the 100 feet. Mr. Colburn had many means of finding out this fact. He might have read it in the newspapers which usually print every week abstracts of Dr. Letheby's reports to the Commissioners of Sewers. As, however, our author has neglected these sources of information, we will supply him with a few facts from the report for 1864:—

"In the course of the year," says Dr. Letheby, "840 examinations have been made of the gas for sulphur—that is, 280 examinations for each company (Great Central, City, and Chartered); and the range has been from 14.4 grains per 100 cubic feet to 35 grains. The average amount in the City gas has been 19.4, and in the Chartered 20.1, and in the Great Central 21.9; and of the 280 examinations of each company, the City gas has on 93 occasions contained more sulphur than is sanctioned by Parliament (20 grains per 100 feet) the Chartered on 139 occasions, and the Great Central 226 occasions." We leave this extract for Mr. Colburn's consideration on publishing a second edition of his book. For the rest we may say that, although the author had an opportunity of producing a book which would have much interest for either engineers, chemists, or the general public, according as the subject was treated, he has brought out one which possesses but little interest for either class of readers.

*Journal für Praktische Chemie.* No. 1, 1865.

THE first article is "A Contribution to our Knowledge of Indium," by C. Winkler. Reich and Richter, the discoverers of indium, have sufficiently described the chemical properties of the new metal; but it is satisfactory to find another chemist engaged in the same research. Winkler sought the metal in Freiburg zinc, which, besides indium, contains a small amount of lead, iron, arsenic, and cadmium, the proportion of indium being only 0.0448 per cent. The oxide of indium can be completely precipitated from an acid solution of the zinc by means of ammonia,

but the amount of ammonia required to obtain a very small amount of the oxide is necessarily large. The author therefore points out some other cheaper methods. To these we shall return, and only stop here to point out the general properties of the metal and its salts. Indium is a lustrous metal, resembling platinum in appearance. It is malleable, and may be cut with a knife. It is not easily oxidised in the air. It dissolves in diluted hydrochloric and sulphuric acids with the evolution of hydrogen; when heated with strong sulphuric acid, sulphurous vapours are evolved; nitric acid quickly oxidises it. Heated in a crucible to a bright red heat, it is volatilised, and burns with a violet-blue flame to oxide, which appears as a yellow deposit on the sides of the crucible.

The specific gravity of the metal at 15° C. is 7.362. There appears to be only one oxide, InO, which is of a straw-yellow colour. The oxide dissolves in acids, forming colourless salts. The author then proceeds to describe various salts and their properties. He also sought to determine the atomic weight, but the results obtained by reducing the oxide in a stream of oxygen are very discordant; those obtained, however, by converting the nitrate into oxide agree much better. Three determinations gave respectively, 35.874, 35.927, and 35.953; the mean, therefore, will be 35.918, which may be taken provisionally as the atomic weight of indium. As everything relating to a new metal is of importance, we shall return to this paper.

The next paper is a continuation of Dr. W. Gibb's researches on the platinum metals, which we have already printed at length.

A short article "On Fluochromate of Potash" shows that powdered bichromate of potash dissolved in fluoric acid yielded ruby-red transparent crystals of a salt having the formula  $KCr_2FO_6$ , exactly corresponding to the chlorochromate of potash, with which, however, it is not isomorphous.

Another short paper "On some Sulphocyanide of Gold Compounds" describes double sulphocyanides of gold and potassium and gold and silver.

The next is an article by Stolba, "On the use of Fluosilicic Acid in the Analysis of Potash and Soda Salts, and in the Separation of the Alkalies." The author gives volumetric processes, a description of which is not easily condensed, so we shall present them in a longer abstract than we can give here.

Short notices of parathionic, mono-sulpholactic, and mono-sulphomalic acids follow, and a longer article by Michaelson, "On the Preparation of the Oxidation Products of Butylalcohol." It will be sufficient to give the titles of these papers.

*Journal de Pharmacie et de Chimie.* March, 1865.

THE Parisian pharmaceutical journal is always for the most part made up of articles from the *Comptes Rendus* of the Academy, which will be found in our weekly notices. In this number, however, we have a paper "On the Action of Chromic and Nitric Acids on the Vegetable Oils," which gives some facts respecting olive oil which may be useful to our readers, now that this oil is so often adulterated with cotton seed oil. We shall, therefore, reproduce the article at considerable length. The only other article noticeable is "On the Detection and Estimation of Arsenic in Subnitrate of Bismuth," which, although it contains nothing new, may be of use to some of our pharmaceutical readers.

**Royal Institution.**—This evening, Friday, March 31, James Glaisher, Esq., F.R.S., "On Aërial Researches."

**Royal Mint.**—We are glad to learn that Dr. Stenhouse, F.R.S., has been appointed by the Master of the Mint non-resident assayer to the Royal Mint, in the place of Dr. Hofmann resigned.



## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

3048. C. A. Martins, Warrington, Lancashire, "Improvements in the application of photography to the ceramic arts or to glass."—A communication from J. B. Obernetter, Munich.—Petition recorded Dec. 6, 1864.

500. J. Nicholas, Aspull, near Wigan, Lancashire, "Improvements in the process and apparatus for producing oil and coke from coal and slack."—Feb. 22, 1865.

### NOTICES TO PROCEED.

2748. A. Estourneaux and L. Beauchamps, Denain, France, "Certain improvements in non-conducting composition for preventing the radiation or transmission of heat or cold."—Nov. 7, 1864.

2801. W. L. Lees, Aston, Warwickshire, "A new or improved composition or cement for uniting or joining substances together, and for other purposes."—Nov. 11, 1864.

2821. F. A. Papps, Bow, "Improvements in malt liquors as tonics."—Nov. 12, 1864.

2832. G. E. Noone, Hastings, "Improvements in machinery for deodorising and utilising the sewage of towns, and in the treatment of other refuse to be combined therewith, both liquid and solid, for manure and chemical use."—Nov. 14, 1864.

2856. S. C. Kreeft, Fenchurch Street, London, "Improvements in the manufacture of iron and steel."—A communication from J. Bozza, Naples.—Nov. 15, 1864.

2948. L. Leister, Glasgow, N.B., "Improvements in obtaining bromine and bromides, and in apparatus therefor."—Nov. 25, 1864.

27. N. Thompson, Abbey Gardens, St. John's Wood, "Improvements in stoppers for bottles, jars, vessels, and tubes, also for ordnance and fire-arms."—Jan. 4, 1865.

88. R. A. Brooman, Fleet Street, "Improvements in engraving upon crystals, glass, and siliceous substances."—A communication from C. R. Maréchal and C. M. T. du Mortay, Metz, France.—Jan. 11, 1865.

481. R. Willison, Alloa, N.B., "Improvements in mashing machines, and in apparatus connected therewith."—Feb. 21, 1865.

## CORRESPONDENCE.

### Continental Science.

PARIS, March 29.

FATHER DURAND is not the first, I think, who has sought to establish a close analogy between sound and colour, inventing a gamut of colours, the harmonies and discords of which perfectly correspond to the musical intervals. The octave Do Do is represented by green and cherry red, and starting from this melodic base the Rev. Father finds the harmonic proportions and the charm of harmonies exactly to correspond with those of music. You want the Father's coloured atlas to show all this, but it is a very expensive book—costs, if I remember rightly, 450 francs, and I am afraid it will not be much looked at. The speculation certainly is curious, but there seems an absence of scientific foundation. A lively imagination, however, such as must have been possessed by the musician in the "Bohemians of Paris," who sat himself down to compose a symphony which was to describe the influence of the colour blue on art, will greatly assist in understanding Father Durand's reasoning. Somebody, Dr. Piesse, I rather think, imagined a gamut of odours, in which perhaps kakodyle and otto of roses constituted the octave, but I forget the harmonic proportions, concords, and discords.

The learned astronomer at Rome, Father Secchi, has again written to M. Faye on the subject of the spectra of the star  $\alpha$  Orion, and of nebulae. In this note he throws out the suggestion that the star just named is now in a state approaching nebulosity—that is, less advanced in its formation than stars properly so-called, and yet more condensed than the nebulae proper. The strange spectrum of this star, he adds, seems destined to unveil one of the great mysteries of creation.

At the last meeting of the Academy M. C. St. Claire Deville announced that at the next meeting he would present the results of thermometric observations made during the last fifty-seven years, which among other things will show that shooting stars have a real influence on sudden variations of temperature.

### Destruction of Parasites.

To the Editor of the CHEMICAL NEWS.

SIR,—In answer to your correspondent's letter respecting the application of bichromate of potash for the destruction of parasites, there is one mistake; either the gentleman gave some of the salt internally, or perhaps the dog licked himself: in this case death would be the result to any animal. I am sorry for the poor dog.

I am, &c.

ISRAEL SWINDELLS.

[We can sympathise with our last week's correspondent on the loss of his dog, but it is some gain to have learnt that bichromate of potash is a virulent poison. We do not remember to have seen it so stated in any book.—ED. C. N.]

### Vapour-Densities.

To the Editor of the CHEMICAL NEWS.

SIR,—The report of my paper "*On Vapour-Densities*," which appeared last week, will, I am afraid, not be very intelligible to your readers. Perhaps a short sketch of it may not be deemed superfluous. I send, therefore, the following.

I would premise, however, that I was rather shocked to find your reporter attributing to Dr. Playfair and me experimental results which are not the product of our labour, but of the accumulated labours of chemists during the last fifty years or more.

In brief, the real purport of my paper is this:—

A vapour, no matter what its chemical composition may be, is a true gas—i.e., it has the same rate, or very nearly the same rate, of expansion as air. This is proved by the correspondence between the theoretical vapour-density and the experimental vapour-density observed by so many chemists in a thousand instances.

The determinations of the vapour-density of chemical substances may be looked upon as an immense experiment, having for its object to give an answer to the question, Has the chemical constitution of a vapour anything to do with its rate of expansion?

As is well known, all that we do in making a vapour density determination of a substance is to compare the weight of a given volume of its vapour at a certain temperature and pressure with the weight of an equal volume of air at the same temperature and pressure.

The pressures at which vapour-densities have been taken are various, but, as a rule, have not exceeded the ordinary barometric pressure. The temperatures at which these determinations have been made are very varied indeed, ranging in general from 0°C. to 300°C.; but in a few instances (in the experiments of Deville and Troost, for example), as high almost as 1000°C. The composition of the substances which have been submitted to vapour-density determination presents the utmost variety, and still the actual results correspond closely with theory, and whenever pains have been taken with a vapour-density determination, the experimental number was very near to the theory. And here the remark may be made that, contrary to what might be



imagined, very heavy vapours do not show any irregularity; indeed, such is the extreme regularity of iodine vapour (one of the heaviest of vapours), that Deville and Troost have employed it for thermometric purposes in their memorable research.

If difference of chemical composition occasioned difference in the rate of expansion, it would be impossible for our thousand different vapours to exhibit the theoretical vapour-density at the different temperatures at which they have been experimented upon. It must be borne in mind that the precise temperature at which any one substance has been examined has been always a matter of chance, the only rule to which chemists have adhered having been to allow an interval of not less than  $30^{\circ}$  or  $40^{\circ}$  to intervene between the boiling point of the liquid and the temperature at which the vapour was measured.

We have, then, as the result of a first-rate induction: "A vapour—no matter what its chemical composition—provided only it be exposed to not more than ordinary barometric pressure, and that it be not within  $30^{\circ}$  or  $40^{\circ}$  of the boiling point of its liquid, has the same expansion co-efficient as air."

Dr. Playfair and myself have extended this proposition. Instead of "not within  $30^{\circ}$  or  $40^{\circ}$  of the boiling point of its liquid," we propose "superheated  $30^{\circ}$  or  $40^{\circ}$ ," and by effecting this superheating by diminution of pressure, we are able theoretically to place any vapour under this condition at any temperature. In how far we have practically realised this idea will be apparent on reference to our paper.

To set aside the above induction, some case wherein a vapour expands irregularly, and yet is known not to suffer decomposition, must be found. We have none such. In the instances which are usually urged to show an irregularity, so far from there being any guarantee of absence of decomposition, there is a high probability of it deducible from the chemical character of the substances concerned.

Given, that vapours expand like air; it follows that whenever two vapour-densities taken at different temperatures disagree, there must have been chemical change; and hence chemists would do well to select the lowest practicable temperature when they make a vapour-density determination from which a formula is to be deduced.

I am, &c. J. ALFRED WANKLYN,

Professor of Chemistry at the London Institution.

#### *On the "Ous-ic" System of Nomenclature.*

To the Editor of the CHEMICAL NEWS.

SIR,—In a highly interesting and important paper lately read before the Chemical Society, Dr. Williamson has proposed that chemists should adopt and more fully carry out the plan of naming compound bodies largely made use of in Gmelin's "Handbook of Chemistry." Before, however, suggestions proceeding from so distinguished a chemist become more generally employed, I trust that I may be permitted, through your columns, to draw attention to certain objections of a weighty character to such a system of nomenclature—objections which have indeed been already urged by myself and others at the meetings of the Chemical Society, but which have not yet, to my knowledge, made their appearance in a written form.

In the first place, then, such names do not indicate with any degree of precision the composition of the substances to which they are attached. For instance, what does the name "stannic oxide" imply? An oxide of tin containing more oxygen than stannous oxide. And what is stannous oxide? An oxide of tin containing less oxygen than stannic oxide.

These names, therefore, give us no information as to the number of atoms of oxygen in a given oxide; they simply say that it contains more or less oxygen than another oxide of the same element, which may or may not exist. Names like "potassic oxide" or "sodic oxide" might even induce a beginner to suppose that there existed lower

oxides of potassium and sodium, for which the termination "ous" was reserved. It may, indeed, be argued that such names are preferable during the rapid transformations that chemical notation has lately undergone. Thus the name "nitrous oxide" serves to designate the lowest oxide of nitrogen, and the name "nitric oxide" that immediately above it, whether we view the former as  $N_2O$  or  $NO$ , or the latter as  $NO$  or  $NO_2$ . But why do they so serve? Simply from their want of precision. Names like "protoxide" and "binoxide," which usually convey to the mind a precise and perfectly definite idea, must of necessity be altered with the progress of science; but this offers no great drawback to their use. Most of the objections that apply to a change of names apply with equal force to a change of formulæ. If, after many variations, we have arrived at our present formulæ, why should we be ashamed to give them consistent names? Why should not water,  $H_2O$ , be called the suboxide of hydrogen, or hydric suboxide; laughing gas,  $N_2O$ , the suboxide of nitrogen, or nitric suboxide; and nitric oxide the protoxide of nitrogen, or nitric protoxide? Even on the "ous-ic" system the name "nitric oxide" is not correctly applied; for surely the substance miscalled nitric anhydride  $N_2O_5$  has more oxygen in it, and therefore has a better claim to the title of nitric oxide.

The second objection is, that analogous bodies do not have analogous names assigned to them. For instance, the protosulphates of magnesium, iron and copper, are called on this system magnesium sulphate, ferrous sulphate, and cupric sulphate. Here we have three distinct terminations employed to indicate three perfectly analogous compounds; and clearly one great defect of such a system is, that it causes us to lose sight of most important analogies. In the case of the copper compound, this difficulty might be, no doubt, smoothed down by calling the red oxide of copper hypocuprous oxide, and the blue oxide cuprous oxide; when blue vitriol would become cuprous sulphate, analogous to green vitriol, or ferrous sulphate. Even then Rose's quadratoxide of copper would loom in the distance, and how that stupendous shade should be named on the "ous-ic" system I hardly venture to surmise—unless, indeed, it were termed the subhypocuprous oxide. I am, &c.

JOHN A. R. NEWLANDS, F.C.S.

Laboratory, 19, Great St. Helens, E.C., March 20.

#### MISCELLANEOUS.

**Iron and Steel Foil.**—A short time since we described the successful results of recent efforts in the direction of manufacturing sheet iron and steel of extraordinary tenuity. The foreign specimens to which allusion was then made appear to have been surpassed by the sheets of rolled steel which have lately been produced by Mr. Parry, of Ebbw Vale. One of these samples of steel foil, which we had an opportunity of inspecting, was much thinner than ordinary writing paper, and weighed only one and a-half grain per square inch, or less than half an ounce per foot super. The outer surfaces, although slightly blackened with oxide, were remarkably uniform, and the texture throughout was perfectly compact. The production of these metallic foils will probably lead to new and interesting applications of sheet iron in the arts.

#### ANSWERS TO CORRESPONDENTS.

X. A.—They depend upon what is to be done, and vary in properly regulated places.

Saggar will find some information in Richardson's and Watts' "Technology," but the subject has never been fully treated of.

J. J. is postponed until next week.

E. H.—Professor Way, we believe, used Bunsen's battery, the number of cells depending upon the light to be produced. The light can hardly be said to have failed, but it has not come into use.

Books Received.—"Book of Perfumes," by E. Rimmel. Dr. Hunt, "On Stammering."

Received with thanks.—Mr. Balfour Stewart; Dr. Redwood; "The Writer of the Article, &c."



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.

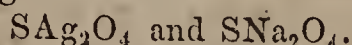
## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

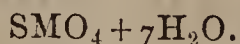
#### SECTION II.—New System of Atomic Weights.

(Continued from page 147.)

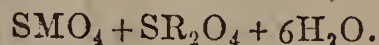
**2. The new system of atomic weights is in harmony with the law of isomorphism.**—Isomorphous bodies are, in fact, represented by analogous formulæ. Thus cuprous sulphide, which is isomorphous with sulphide of silver,  $\text{Ag}_2\text{S}$ , is represented by the formula  $\text{Cu}_2\text{S}$ ,\* whilst Gerhardt gives it the formula  $\text{Cu}_4\text{S}$ .† Sulphate of silver and anhydrous sulphate of sodium receive the analogous formulæ



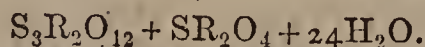
The isomorphous sulphates of the magnesian series are represented by the formula



The double sulphates of the same series receive the formula



Lastly, the composition of alums is represented by the formula



**3. The new system of atomic weights is in harmony with the relations existing between the densities of gases and vapours, and their molecular weights.**—1. Let us first consider the relations discovered by Gay-Lussac between the densities of simple gases and their atomic weights. With some exceptions these densities are proportional to the atomic weights, in such a manner that if, instead of being compared with air, they are compared with hydrogen taken as unity, the same numbers will express their densities and atomic weights. The following table will show this ‡:—

Names of Simple Bodies.	Densities of gases and vapours compared with air.	Densities compared with hydrogen.	Atomic weights.
Hydrogen . . .	0.0693	1	1
Oxygen . . .	1.1056	15.9	16
Nitrogen . . .	0.9714	14.0	14
Sulphur (at 1000°) . . .	2.22	32.0	32
Chlorine . . .	2.44	35.2	35.5
Bromine . . .	5.393	77.8	80
Iodine . . .	8.716	125.8	127

It was upon the remarkable relation between the densities and atomic weights that this celebrated proposition of Ampère and Berzelius was chiefly founded: *equal volumes of gases contain the same number of atoms*. One atom of the preceding gases corresponds to one volume. We shall see that, slightly modified, this proposition is also applicable to compound gases.

But we ought not to pass over in silence the exceptions which have been discovered to the preceding law. Phosphorus, arsenic, mercury, and cadmium diverge from it. The densities of their vapours compared with that

of hydrogen are not the same as their atomic weights. They only present a simple relation with their atomic weights, as shown by the following figures:—

Names of Simple Bodies.	Vapour densities compared with air.	Vapour densities compared with hydrogen.	Atomic weights.
Phosphorus . . .	4.42	63.8	31
Arsenic . . .	10.6	153.0	75
Cadmium . . .	3.94	56.9	112
Mercury . . .	6.976	100.7	200

It is seen that the vapour densities of phosphorus and arsenic lead to double the atomic weights assigned to these elements, whilst, on the contrary, the vapour densities of cadmium and mercury give atomic weights half as great as those which belong to them. In other words, the first two vapour densities are twice as large as they should be; the second are half as large, and whilst the atoms of other gases correspond to one volume, those of phosphorus and arsenic correspond to half the volume, and those of mercury and cadmium correspond to two volumes.

With phosphorus and arsenic the anomaly is of the same character as that presented by the vapour of sulphur at 500°, but the vapours of the former two elements do not appear to expand like that of sulphur at higher temperatures so as to be brought to their normal densities. It is, however, possible that this phenomenon of expansion does not commence, in the case of these very dense vapours, except at temperatures inaccessible to our means of investigation.

Mercury and cadmium, to which must probably be added zinc, present an inverse anomaly; their vapours, in the free state, are too little condensed. We will endeavour presently to explain this fact by comparing these metals with certain organic radicals which offer analogous phenomena. At present it remains for us to show that these exceptions do not embarrass the theory. They are apparent when the bodies in question are examined in the free state, but they disappear when the most definite compounds of these same bodies are taken. When combined with hydrogen, chlorine, bromine, iodine, and with organic radicals the bodies in question, that is to say phosphorus, arsenic, mercury, and zinc, possess their normal vapour density. To show that this is so, it is necessary to recall and to accurately define the relations which exist between the atomic composition of compound bodies and their densities in the state of gas or vapour.

II. These relations are of the most simple character, and it may be expressed by saying that *equal volumes of gases contain the same number of molecules* under identical conditions of temperature and pressure, and that consequently the *molecular weights of compound bodies are proportional to their densities in a state of gas or vapour*. This is the proposition of Ampère and Berzelius slightly altered in its wording, and applicable in its new form to simple as well as to compound gases. It here refers to molecules, and not to atoms, for it is evident that compound gases do not always contain, for the same volume, the same number of atoms, in the sense which we have used this word.

In fact, we know that 2 volumes of hydrochloric acid contain 1 volume or 1 atom of chlorine, and 1 volume or 1 atom of hydrogen—that is to say, 2 elementary atoms; whilst 2 volumes of ammonia contain 1 volume or 1 atom of nitrogen and 3 volumes or 3 atoms of hydrogen—that is to say, altogether 4 elementary atoms. Experience teaches us, on the other hand, that 2 volumes of hydrochloric acid combine with 2 volumes of ammonia. We are, therefore, led to regard the quantity of

\*  $\text{Cu}=63.5$ ;  $\text{S}=32$ .

†  $\text{Cu}=31.75$ ;  $\text{S}=32$ .

‡ To reduce the densities of gases to that of hydrogen, it is only necessary to multiply them by  $14.44 = \frac{1}{0.0693}$ , which is the ratio between the density of air and that of hydrogen.



hydrochloric acid which contains 1 atom of chlorine and 1 atom of hydrogen (and which corresponds to 2 volumes) as representing 1 molecule of this acid; and to look upon the quantity of ammonia which contains 1 atom of nitrogen and 3 atoms of hydrogen (and which corresponds to 2 volumes) as representing 1 molecule of ammonia. Thus hydrochloric acid and ammonia contain for the same volume an equal number of molecules, and it is the same for the other compound gases.

In the case of hydrochloric acid and ammonia, which we will continue to take as examples, their molecular weights correspond in consequence to weights of two volumes of each gas—that is to say, to their double density, for the density represents the weight of one volume (or unit of one volume). If, therefore, the densities of these two gases were expressed in relation to hydrogen, which represents unity in the system of atomic weights, it would be sufficient to double the numbers expressing these densities to obtain their molecular weights. That is to say, to obtain the latter the densities found in relation to air must be multiplied by twice the ratio of the density of air to the density of hydrogen, or by—

$$2 \times \frac{1}{0.00093} = \frac{2}{0.00093} = 2147.8$$

Let us, therefore, make the calculations we have just given, not only for compound bodies, but also for the elements, and let us group the bodies in such a manner as to bring out certain analogies. We shall thus find the molecular weights of all these bodies; we can construct their formulæ, and can verify if the atomic weights deduced from the vapour-densities of compound bodies are identical with those we have already given. In the following table the numbers inscribed in the third column represent the double densities of volatile substances compared with hydrogen; these numbers agree sensibly with those given in the fourth column, and which represent the molecular weights deduced from chemical considerations.

Names of bodies.	Densities.	Double densities, as compared with hydrogen.	Molecular weights.	Formulæ.
Hydrogen . . . . .	0.0693	2.0	2	H <sub>2</sub>
Chlorine . . . . .	2.44	70.5	71	Cl <sub>2</sub>
Bromine . . . . .	5.54	159.0	160	Br <sub>2</sub>
Iodine . . . . .	8.716	251.7	254	I <sub>2</sub>
Cyanogen . . . . .	1.806	52.1	52	Cy <sub>2</sub>
Methyl . . . . .	1.0365	29.9	30	Me <sub>2</sub>
Hydride of methyl . . . . .	0.558	16.1	16	MeH
Ethyl . . . . .	2.0462	59.09	58	Et <sub>2</sub>
Oxygen . . . . .	1.1056	31.9	32	O <sub>2</sub>
Sulphur . . . . .	2.22	63.5	64	S <sub>2</sub>
Water . . . . .	0.6235	18.	18	H <sub>2</sub> O
Sulphuretted hydrogen . . . . .	1.1912	34.4	34	H <sub>2</sub> S

§ This fact may be established in another way; equal volumes of simple or compound gases contain the same number of molecules, the molecular weights of which are in proportion to their densities. Thus the density of hydrochloric acid is to the density of hydrogen as the molecular weight of hydrochloric acid is to the molecular weight of hydrogen: this latter is = 2, for it corresponds to two atoms. The molecular weight of hydrochloric acid is obtained, consequently, by the following proportion:—

$$\frac{1.247}{0.0693} = \frac{x}{2}, \text{ whence } x = 1.247 \times \frac{2}{0.0693}$$

Thus, to find the molecular weight, it is only necessary to multiply the densities by the constant ratio  $\frac{2}{0.0693} = 2888$ . The numerator 2 thus represents the molecular weight of hydrogen. We have given above the reasons which have induced MM. Dumas and Gerhardt to look upon free hydrogen—that is to say, one molecule of hydrogen—as formed of 2 atoms. Other simple bodies have been regarded in the same light.

Names of bodies.	Densities.	Double densities, as compared with hydrogen.	Molecular weights.	Formulæ.
Sulphurous acid . . . . .	2.234	64.5	64	SO <sub>2</sub>
Sulphuric acid . . . . .	2.763	79.8	80	SO <sub>3</sub>
Nitrogen . . . . .	0.9714	28.0	28	N <sub>2</sub>
Protoxide of nitrogen . . . . .	1.527	44.1	44	N <sub>2</sub> O
Binoxide of nitrogen . . . . .	1.038	29.98	30	NO
Hyponitric acid . . . . .	1.72	49.5	46	NO <sub>2</sub>
Methylamine . . . . .	1.08	31.19	31	NMeH <sub>2</sub>
Ammonia . . . . .	0.591	17.07	17	NH <sub>3</sub>
Phosphorus . . . . .	4.42	127.6	62	P <sub>4</sub>
Phosphuretted hydrogen . . . . .	1.184	34.2	34	PH <sub>3</sub>
Protochloride of phosphorus . . . . .	4.742	136.9	137.5	PCl <sub>3</sub>
Oxychloride of phosphorus . . . . .	5.3	153.1	153.5	POCl <sub>3</sub>
Arsenic . . . . .	10.6	306	150	As <sub>4</sub>
Arseniuretted hydrogen . . . . .	2.695	77.8	78	AsH <sub>3</sub>
Chloride of arsenic . . . . .	6.3006	181.9	181.5	AsCl <sub>3</sub>
Iodide of arsenic . . . . .	16.1	464.9	456	AsI <sub>3</sub>
Triethylarsine . . . . .	5.61	162.0	162	AsEt <sub>3</sub>
Kakodyle (arsen-bimethyl) . . . . .	7.1	205.0	210	As <sub>2</sub> Me <sub>4</sub>
Oxide of carbon . . . . .	0.967	27.9	28	CO
Carbonic acid . . . . .	1.529	44.1	44	CO <sub>2</sub>
Marsh gas . . . . .	0.559	16.1	16	CH <sub>4</sub>
Chloroxycarbonic gas (chloride of carbonyl) . . . . .	3.399	98.2	99	COCl <sub>2</sub>
Chloride of carbon . . . . .	5.415	156.4	154	CCl <sub>4</sub>
Sulphide of carbon . . . . .	2.645	76.4	76	CS <sub>2</sub>
Chloride of silicium . . . . .	5.939	171.5	170	SiCl <sub>4</sub>
Silicium-ethyl . . . . .	5.13	148.1	144	SiEt <sub>4</sub>
Fluoride of silicium . . . . .	3.600	103.9	104	SiF <sub>4</sub>
Tetreehylic silicate . . . . .	7.325	211.5	208	Si(EtO <sub>4</sub> )
Perchloride of tin . . . . .	9.199	265.7	260	SnCl <sub>4</sub>
Stannotetreehylic (stannethide) . . . . .	8.021	231.6	234	SnEt <sub>4</sub>
Stannodiethyl - dimethyl . . . . .	6.838	197.5	206	Sn { Et <sub>2</sub> Me <sub>2</sub> }
Chloride of Stannotriethyl (of sesquistannethyl) . . . . .	8.430	243.4	240.5	Sn { Et <sub>3</sub> Cl }
Bromide of stannotriethyl . . . . .	9.924	286.6	285	Sn { Et <sub>3</sub> Br }
Iodide of stannotriethyl . . . . .	10.32	298	290	Sn { Me <sub>3</sub> I }
Dichloride of stannodiethyl . . . . .	8.710	251.5	247	Sn { Et <sub>2</sub> Cl <sub>2</sub> }
Dibromide of stannodiethyl . . . . .	11.64	336.1	336	Sn { Et <sub>2</sub> Br <sub>2</sub> }
Chloride of zirconium . . . . .	8.15	235.4	331	ZrCl <sub>4</sub>
Chloride of titanium . . . . .	6.836	197.4	192	TiCl <sub>4</sub>
Chloride of boron . . . . .	3.942	113.7	117.5	BoCl <sub>3</sub>
Bromide of boron . . . . .	8.78	253.6	251	BoBr <sub>3</sub>
Fluoride of boron . . . . .	2.3694	68.4	68	BoF <sub>3</sub>
Boracitriethyl . . . . .	3.4006	98.2	98	BoEt <sub>3</sub>
Boracitrimethyl . . . . .	1.9314	55.8	56	BoMe <sub>3</sub>
Trimethylic borate . . . . .	3.59	103.7	104	Bo(MeO <sub>3</sub> )
Triethylic borate . . . . .	5.14	148.4	146	Bo(EtO <sub>3</sub> )
Chloride of vanadium . . . . .	6.14	177.3	175	VCl <sub>3</sub>
Chloride of antimony . . . . .	7.8	225.3	228.5	SbCl <sub>3</sub>

|| It is seen that the molecular weights of phosphorus and arsenic, as deduced from their vapour densities, are double those which their analogy to nitrogen would lead to be given to them. Whilst the molecule of free nitrogen is N<sub>2</sub> = 2 vols., the molecules of free phosphorus and arsenic are P<sub>4</sub> and As<sub>4</sub> = 2 vols.

¶ See note II.



Names of bodies.	Densities.	Double densities, as compared with hydrogen.	Molecular weights.	Formulae.
Triethylstibine (stibethyl) . . . . .	7.23	208.8	209	SbEt <sub>3</sub>
Chloride of bismuth. . . . .	11.35	327.8	316.5	BiCl <sub>3</sub>
Oxychloride of chromium . . . . .	5.5	158.8	156.5	CrO <sub>2</sub> Cl <sub>2</sub>
Chloride of aluminium . . . . .	9.34	269.7	268	Al <sub>2</sub> Cl <sub>6</sub>
Bromide of aluminium . . . . .	18.62	537.7	535	Al <sub>2</sub> Br <sub>6</sub>
Iodide of aluminium. . . . .	27.0	779.8	817	Al <sub>2</sub> I <sub>6</sub>
Perchloride of iron . . . . .	11.39	328.9	325	Fe <sub>2</sub> Cl <sub>6</sub>
Osmic acid . . . . .	8.89	256.7	263.2	OsO <sub>4</sub>
Zinc-ethyl . . . . .	4.259	123	123	ZnEt <sub>2</sub>
Mercury . . . . .	6.976	201.4	200	Hg"
Chloride of mercury. . . . .	9.8	283	271	HgCl <sub>2</sub>
Bromide of mercury. . . . .	12.16	351.2	360	HgBr <sub>2</sub>
Iodide of mercury . . . . .	15.9	459.2	454	HgI <sub>2</sub>
Mercuric dimethyl . . . . .	8.29	239.4	230	HgMe <sub>2</sub>
Mercuric diethyl . . . . .	9.97	287.9	258	HgEt <sub>2</sub>
Mercurous chloride . . . . .	8.21	237.1	235.5	HgCl
Mercurous bromide . . . . .	10.14	292.8	280	HgBr
Ethylene . . . . .	0.9784	28.2	28	[C <sub>2</sub> H <sub>4</sub> ]"
Chloride of ethylene. . . . .	3.4434	99.4	99	[C <sub>2</sub> H <sub>4</sub> ]"Cl <sub>2</sub> .

The results which are given in the preceding table suggest the following remarks:—

Firstly, if the law of Ampère is applicable to simple as well as to compound bodies, either in the state of gas or vapour, it will be seen that the molecules of both correspond to two volumes of vapour.

Secondly, the exceptions to this law, which are apparent in the case of several simple bodies, will not apply to volatile compounds of the same bodies. Phosphorus, arsenic, mercury, cadmium, and zinc, in their combinations with hydrogen, chlorine, bromine, iodine, and organic radicals, give such vapour-densities that the atomic weights deducible from them, conformably to the law of Ampère, are the same as the atomic weights founded upon chemical considerations.

Thirdly, the molecular weights which may be deduced, conformably to this law, from the densities of a great number of combinations, are identical with the molecular weights deduced from chemical considerations, provided that numbers which agree with the law of Dulong and Petit are taken for the atomic weights of a great number of elements.

(To be continued.)

#### Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.\*

IN 1788 Captain Arrhenius discovered in the quarries at Ytterby a black mineral, which Gadolin analysed six years afterwards, and which he discovered contained a new earth.

Ekeberg gave to the mineral the name of *gadolinite*, and to the earth that of *yttria*. In spite of appearances to the contrary, the latter was found to be far from constituting a homogeneous substance, for in 1802 Ekeberg extracted glucinum from it, Berzelius cerium in 1815, Mosander lanthanum and didymium in 1839, and erbium and terbium in 1843. The second, third, and fourth of these bodies is found in much greater abundance in the cerite of Bastnaes.

The seven bodies above enumerated have been, since their discovery, the subject of several important works;

but it is to be regretted that their history has not advanced in the same ratio, as, in spite of the well-merited confidence inspired by Mosander's works, the existence of erbium and terbium is generally regarded as problematical, and even in those which are best known a great many essential points remain to be elucidated.

In the first place, none of them except glucinum has been obtained in a free state. It will probably be found in time that the powders described as cerium, didymium, yttrium, &c., do not give a correct idea of these isolated metals. Each of them forms a powerful salifiable protoxide base, but the superior and inferior degrees of oxidation, if there are any, remain almost or wholly unknown. Thus, for instance, cerium gives an oxide Ce<sub>3</sub>O<sub>4</sub>, capable of forming well-defined salts; but does its sesquioxide exist? Mosander, Marignac, and Rammelsberg have never obtained it, while Hermann says that it forms readily, and besides admits the existence of a more oxygenated compound. According to Göbel, the cerous formiate, excluded from the air and calcined, is reduced to the metallic state. This is probably incorrect, but the reducing properties of formic acid being ascertained, what is the composition of the residue obtained by Göbel? Didymium partially superoxidises so as to unite with oxygen in the atomic proportion of about 32 to 33. It is the same with erbium, and probably with lanthanum also. Is this exception to the general law of multiple proportions an acquisition to science, or may oxidation be carried still further, and if so, what is its limit? Or again, as certain facts would lead us to suppose, is the small excess of oxygen absorbed by some new metal, which will be brought to light by future researches? &c.

Having at my disposal abundant materials for the elucidation of all these points, and having during the last few years become well acquainted with the reactions of the metals in cerite and gadolinite, I devoted to them a series of researches, the results of which I will give in several successive memoirs.

**1. On Erbium and Oxide of Erbium.**—Scheerer observed that yttria, heated in a current of hydrogen, loses its yellow colour, and recovers it after calcination in the air. The alteration of weight during these two operations being so small, Scheerer concluded that some foreign oxide must be present in the yttria, probably the recently discovered oxide of didymium.

Mosander undertook some researches on this subject, and in 1843 ascertained that the body called yttria is in reality a mixture of three salifiable oxides, two of which, the most powerful, are white and the third yellow. Mosander gives them the names of yttria, terbium, and erbium, and gives a method of separating them, and their chief characteristic reactions. His results were confirmed by Berzelius, Svanberg, and Scheerer.

Since then erbium, terbium, and yttria have not, to my knowledge, been made the subject of any fresh researches, and even the existence of the first two is not, as I have already stated, universally admitted.

In 1841 M. Plantamour collected at Ytterby a large quantity of gadolinite and yttrantalites, which, with his accustomed kindness, he placed at my disposal, and which formed the subject of studies the results of which are as follows:—

My object was again to prove the existence of erbium and terbium, and, this being accomplished, to complete their history according to the characteristics which most distinguished them, either one from another or from analogous earths. For this purpose the best plan appeared to me to be to repeat and at the same time to extend Mosander's experiments. I will first speak of

\* Archives des Sciences Physiques et Naturelles, Geneva.



erbium and then of terbium and yttria, ending by a chemical and crystallographic examination of the salts of which I treat.

It seemed to me superfluous to seek for a new process for extracting yttria from gadolinite and separating it from the accompanying bases, so I confined myself to the path indicated by Berzelius in his *Traité de Chimie*.

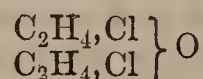
Yttria being obtained free from lime, manganese, glucina, cerium, &c., I had the choice of several methods for extracting erbium and terbium. After several comparative trials, I determined on employing binoxalate of potash to effect the fractional precipitations on which is founded the separation of the three earths. In this instance I proceeded as follows:—

After having dissolved yttria in nitric acid and acidulated the filtered liquid with a little sulphuric acid, I heated the liquid to 70° or 80° C., and then added to it, drop by drop, a cold saturated solution of binoxalate of potash. A precipitate was thus formed, which immediately redissolved by shaking, until a last drop produced permanent turbidity. I then stopped adding the reagent, and left the whole to stand for several days. At the end of this time there was formed at the bottom of the glass, and on portions of the sides which had been rubbed by the rod, a crystalline deposit of a potassico-earthly oxalate, which was separated by filtration. This operation repeated fifteen times under exactly the same conditions invariably gave oxalates, which left after calcination a yellow residue, from which water separated carbonate of potash. From this number the precipitates obtained were less crystalline, had a scarcely appreciable rose tint, and gave only an almost colourless earth. According to the depth of their colour, these residues were assorted and united in two lots, to be treated as will be described.

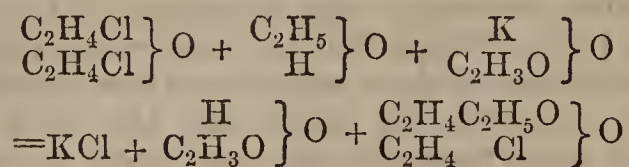
(To be continued.)

#### On Some of the Reactions of Monochloric Ether.

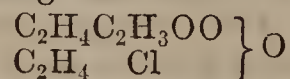
MONOCHLORIC ether



is decomposed when acted on by alcohol and acetate of potash simultaneously, as is shown by the following equation:—



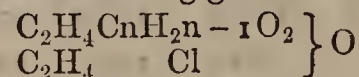
Besides chloride of potassium and acetic acid, a new body is formed, which may be considered as ether, in which one equivalent of hydrogen is replaced by chlorine, and in the place of another equivalent of hydrogen  $\text{C}_2\text{H}_5\text{O}$ , oxide of ethyl has entered. This substance boils at 155° Cent., and its vapour has a pleasant smell; and was some short time since discovered by Liebig amongst other products formed when ethylate of soda acts on monochloric ether, but which could not then be obtained in a pure state. Anhydrous oxide of silver acts very energetically on monochloric ether, or on a solution of monochloric ether in ether forming the same new substitution product. Dry acetate of oxide of silver acts on monochloric ether when the temperature is considerably raised; and amongst other products formed in this reaction the following substance was discovered:—



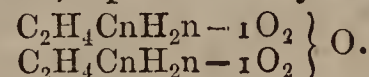
This body is also to be considered as monochloric ether,

in which one equivalent of chlorine has been replaced by the radical  $\text{C}_2\text{H}_3\text{O}$ . This substance has a strong penetrating odour, and boils at about 170° Cent., and by distillation is slightly decomposed, forming acetate of ethyl; but by a solution of caustic potash completely so. Formiate of oxide of lead reacts on monochloric ether in the same manner as acetate of oxide of silver, only the reaction takes a much longer time before it is completed.

The above researches will allow us to hope that the salts of the fatty acids, when acting on monochloric ether, will give a series of compounds which may be represented by the following general formula:—



and should we also be able to replace the second equivalent of chlorine in monochloric ether by a radical of the general formula  $\text{CnH}_{2n-1}\text{O}_2$ , we shall have another series of compounds, represented by the general formula



The results of this further research will be communicated at some later period.—*Extract of a paper read by Dr. Alexander Bauer, Professor of Chemistry at the Imperial Academy of Science, Vienna, December 1, 1864.*

#### Action of Sodium on Carbonic Ether, by M. H. GAL.

CARBONIC ether is formed by the reaction of sodium on oxalic ether, and it is usually said that the action of the metal must be continued as long as gas is disengaged. But if this is done no carbonic ether will be obtained, for the sodium acts on the ether, and if the re-action be stopped at the proper time a considerable quantity of a liquid boiling at 79° is obtained. Sodium acts on this liquid also with disengagement of hydrogen; it is soluble in water, and analysis attributes to it the formula of alcohol. The formation of this compound is inexplicable by any equation the author can imagine.

#### On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, F.C.S.

(Continued from page 76.)

**XI. Rise of Scientific Societies.**—Inasmuch as in the following papers we shall have frequently to allude to the labours of various scientific societies in connection with the subject under consideration, and as, moreover, institutions of this nature have done much to further the progress of experimental philosophy, I conceive it will not be out of place here to give a short account of their rise, and of their effect on the progress of physical science.

Among the ancients there was no experimental philosophy; we read of a few isolated experiments—such as the electrical experiment of Thales, the proof of the materiality of air proposed by Anaximenes, and the magnetic experiment mentioned by Lucretius—but these were exceptions; men preferred to rely on the unaided intellect rather than to call in assistance from external sources; they preferred to give a theoretical explanation of a natural phenomenon, and to reason on that, all unproven as it was, as if it were a well-established and absolute truth. Let any one read the “Physics” of Aristotle if he wishes to comprehend the tone of physical thought which prevailed among the ancients. Such a treatise is intolerable to a follower of the Baconian method; the long, dreary trains of reasoning, perpetually ramifying in all directions, and the continued proposal of one theory to support another, so divert the mind from the subject discussed, that it ulti-



mately grasps the explanation with difficulty. Such a system has no solid basis; destroy one theory in any part of the explanation, and the whole mass of reasoning in a moment falls to the ground. When we remember that this was the scientific text-book for 2000 years, can it be wondered that the physical sciences are now almost new born in the world?

Passing onward to this side of the Christian era, we find a manifest lessening of intellectual activity; the golden age of literature among the ancients had passed away. Greece for a long period had ceased to furnish writers of eminence; the Romans, tired of conquest, became indolent, luxury and corruption followed, and, as a consequence, enervation of intellectual power. Then came those uncivilised Northern races, which, in destroying the Roman Empire, at the same time crushed all traces of learning; but that unyielding bosom, while it swept away a debased and impoverished literature, did also remove the causes which had conduced to its impoverishment.

From the time of the destruction of the Roman Empire till the fifteenth century, science, in common with all other pursuits depending on mental energy, was utterly neglected. There could be but little learning during the Middle Ages. The priests were the most educated members of the community, and on that account they possessed immense power over the human mind, for on them devolved not only spiritual but also temporal teaching. But they were an ignorant class of men, and cared for nought but to uphold and maintain the dominion of their Church, and their own dominion over the minds of men. There could be no scientific progress; for had not that Church, now dominant and supreme, condemned the study of physical science? had it not affirmed that the Aristotelian philosophy was sufficient for all purposes, and ruled that it alone should be followed? In the fifteenth century the power of the Church began to wane; Savonarola had arisen, and had waged war against the absolute dominion of the hierarchy; Sarpi was soon to appear; a few had ventured to dispute the authority of Aristotle in physical matters, and had been punished for their freedom of thought. The human mind began to arouse itself after its long imprisonment, and to strive to burst asunder its fetters, for the Church had at first bound it captive with silken threads easy to be broken, but eventually they became fetters of steel. A yearning for intellectual progression was apparent, a desire to employ the long neglected attribute of reason; and now in that land in which more than a thousand years before learning had been almost blotted out, there arose a regenerated intellect—a new tone of thought; Italy was the cradle in which it gained vigour, and it passed out thence to civilise the whole world.

Among the greatest experimental philosophers of the Middle Ages, I may mention Roger Bacon\*, Albertus Magnus, the Spanish philosopher Averröes, and Leonardo da Vinci. We may briefly refer to the first and last of these.

The sixth part of Bacon's "Opus Majus"† bears the title "De Scientia Experimentalis." The first chapter treats "of the utility of experimental science;" the last "of the dignity of the experimental arts." Throughout the work we find a strong advocacy of experiment as a guide to the intellect to assist it in arriving at the causes

of unusual physical effects. No treatise at all comparable to this appeared during the Middle Ages—indeed, not until the publication of the "Novum Organum."

Leonardo da Vinci‡ is known to every one as a great painter, but it is not so generally known that he was a great mathematician, physicist, and engineer, and by no means an inferior musician. His physical views are far in advance of those of either his own or the succeeding age; our chief knowledge of them is derived from some of his unpublished MSS., which are preserved in the King's Library at Paris; many of these were translated into French by Venturi, and published in 1797.§

The following passage is written in the true spirit of inductive philosophy; indeed, no one who has read the "Novum Organum" can fail to be reminded of many similar passages therein:—"Of Method.—Theory is the general, practice the soldiers. The interpreter of the artifices of Nature is experiment. It never deceives; it is our judgment that sometimes deceives itself, because it expects results which experiment refuses. We must consult experiment, varying the circumstances until we have deduced general rules, for it alone can furnish reliable rules. But you ask me, of what advantage are these rules? I answer that they guide us in the researches of Nature, and the operations of art. They prevent us from deceiving ourselves or others by promising ourselves results which we cannot obtain."

I may also mention a sentence bearing directly on our subject, in which we have proof of most advanced physical knowledge for the period, and which shows that Leonardo da Vinci was aware that fire is not elemental, and that it requires air for its sustenance—a theory, I need not say, wholly at variance with that maintained by his contemporaries:—"Of Flame and Air.—There is smoke in the centre of the flame of a wax candle, because the air which enters into the composition of the flame cannot penetrate to the middle of it. It stops at the surface of the flame, and condenses there; in becoming aliment of the flame, it is transformed into it, and leaves a void space which is filled successively by other air."

In the middle of the sixteenth century the Church armed itself with a new and powerful weapon to suppress free thought; this was the right which it assumed of prohibiting the printing and reading of certain books which were believed to inculcate injurious ideas. The first catalogue of prohibited books was published by Paul IV. in 1559. In it no less than sixty-one printers were condemned, and all works issuing from their presses were forbidden to be read. Theological treatises were not the only works submitted to examination, scientific works did not escape; thus I find at the commencement of Baptista Porta's four books "De Aëris Transmutationibus," an order from the examiner allowing them to be printed, because, he writes, "in quibus nihil inveni, quod sit contra fidem, aut bonos mores."||

Towards the end of the sixteenth century, we find a greater freedom of physical thought beginning to be

‡ Born 1452. Died 1519.

§ "Essai sur les ouvrages physico-mathématiques de Leonard da Vinci, avec des fragmens tirés de les manuscrits." Par J. B. Venturi. Paris. An v. (1797.)

|| The order is conveyed in the following form:—

"Imprimatur, si videbitur R.P.M. Sacri. Pal. Apost.

"Cæsar Fidelis Vices-gerens.

"Iussu Reuerendissimi P. F. Ludouici Ystella Sacri Palitij Magistri. Ego Alexander de Angelis Societatis Iesu, et Sacrae Theologiæ Professor, legi quatuor libros Meteororum Io. Baptistæ Portæ Neapolitani, in quibus nihil inveni, quod sit contra fidem, aut bonos mores, sed dignos eos indico qui in lucem prodeant, si ita videbitur ijs, quorum interest. Data in nostro Collegio Romano die 22 Novembris, 1608.

"Ego Alexander de Angelis qui supra."

\* Born 1214. Died 1284.

† "Fratris Rogeri Baconis, Opus Majus." Ad Clementum Quartum. Ex M. S. Codice Dublinensi cum aliis quibusdam collato, nunc primum edidit S. Jebb, M.D. Londini. 1733.



apparent; many eminent men now arose, among them may be mentioned Telesio, Aconcio, Nizzoli, our countryman Gilbert, Giordano, Bruno, and Galileo, great and original thinkers, worthy to be revered in all ages, for they broke down the barriers which had so long protected the Aristotelian philosophy, and by so doing prepared the world for the change about to be effected by the cardinal and sovereign intellect of Francis Bacon. Giordano Bruno suffered at the stake for the too open expression of his views; Galileo was compelled to resign his lectureship at Pisa, because he proved the fallacy of Aristotle's theory in regard to the velocity of falling bodies; at a later date he was imprisoned for daring to promulgate the Copernican theory of the earth's motion:—these were the last great efforts of the hierarchy to curb and restrain the workings of the human mind, the last acts of oppression to be practised by a long dominant Church.

Although the Aristotelian philosophy had long been falling into disrepute, no system at all comparable to it had been propounded, and it was not till the publication of Bacon's "*De Augmentis Scientiarum*," that it received its death blow. Mankind was now taught to interrogate Nature, not by reason alone, but by reason aided by experiment; not by the use of the syllogism, but by induction. From this period commences the epoch of modern science.

A few literary societies appeared in Italy in the fifteenth century, but their formation was not encouraged; in 1468 Paul II. arrested the members of a literary society on the charge of introducing foreign superstitions; they were ordered to be tortured and imprisoned for a year.

In the sixteenth century societies became much more numerous; they existed, however, almost exclusively in Italy, and were generally devoted to the improvement of the Italian language, or to the study of the Platonic philosophy.

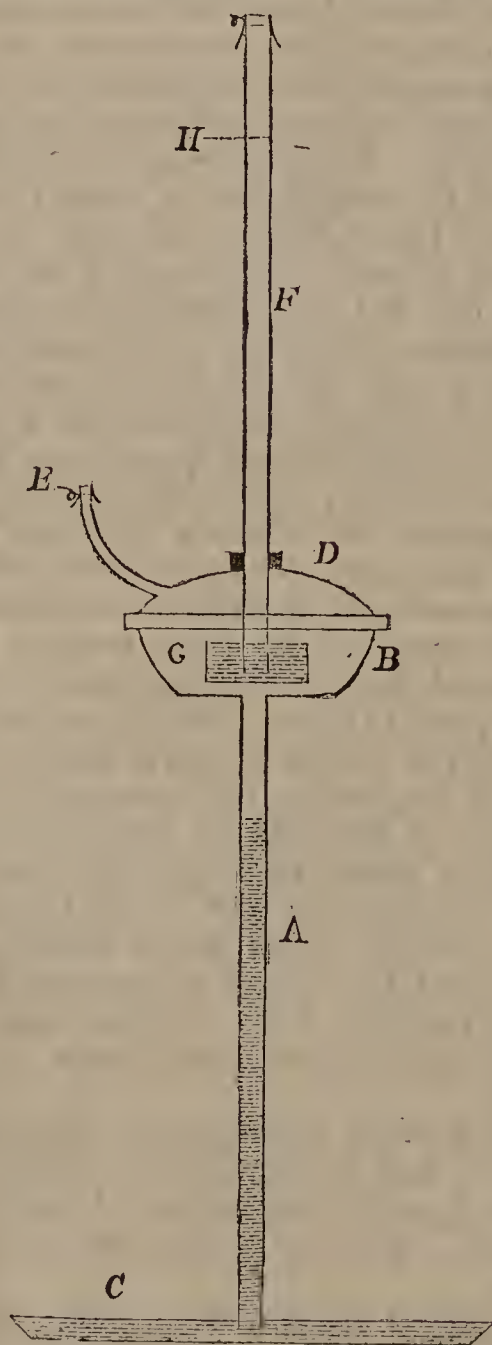
The first scientific society was established by Baptista Porta in the middle of the fifteenth century. It was called the "*Academy of the Secrets of Nature*," and consisted solely of men who had discovered something of importance in medicine or natural philosophy. From the name of the society it was believed that magic and illicit arts were practised by its members, Porta was summoned to appear at Rome, and commanded by Paul III. to discontinue the meetings of the society. While in Rome he was elected a member of the "*Lyncean*," a very celebrated academy, to which Galileo also belonged.

The first scientific society of importance was the *Accademia del Cimento*, established in Florence in 1657 by Duke Leopold of Tuscany. The object of this society was "to make experiments and relate them," and to ignore all theoretical matter. It proved worthy of its name "*del Cimento*," but, unfortunately for science, it endured only ten years, for Leopold was created a cardinal in 1667, and by leaving Florence withdrew his direct patronage from the society. During the ten years of its existence, however, a large number of experiments were made by its members. A volume containing an account of them was published by the Secretary in 1667, from which we extract the following relating to the subject under consideration.

¶ This work is in the form of a beautifully printed folio, with numerous full page plates of apparatus. It is entitled "*Saggi di Naturali Esperienze, fatte nell' Accademia del Cimento. E descritte del Segretario di essa Accademia. In Firenze, 1667.*" It was done into English in 1684 by Richard Waller, and printed by order of the Royal Society.

In the early part of the work we find the description of a method of determining the comparative amounts of moisture in the air of different localities. The apparatus employed for the purpose was somewhat similar in form to the "ice calorimeter" of Lavoisier and Laplace. It consisted of a hollow metal cylinder lined inside with cork, open above, and terminated below by a cone. Ice was placed within it, and there was a lateral tube communicating with the interior for allowing the water produced by the liquefaction of the ice to flow away. The aqueous vapour in the atmosphere would obviously be condensed by the cold surface of the metal, and the water would trickle down the side of the cylinder, and finally drop from the apex of the cone; it was received in a graduated vessel. By noting the amounts of water collected in different localities in a given time, the comparative amounts of aqueous vapour in the air of those localities could be determined.

Under the title of "*An experiment of Mr. Robervall's in favour of the air's pressure upon inferior bodies, tryed in our Academy*," we have an account of a very ingenious experiment, performed by means of the following apparatus:—A is a glass tube, forty-six inches long, terminated above by a cup-shaped enlargement B, and dipping



below into a vessel of mercury C. B is furnished with a glass cover D, the edges of which are accurately ground so as to form an air-tight connection with B. From D there projects a tube E. The cover D has an orifice in its upper part, through which passes air-tight a tube F, forty-six inches long, the lower end of which dips into a small vessel G, containing mercury, placed within B. Wet bladder is tied over the lower orifice of A. Mer-



cury is now poured into the apparatus until it issues from E, which is then closed with wet bladder, and the pouring of the mercury continued until the tube F is full:—bladder is then tied over its orifice. The bladder is now removed from the lower orifice of A, when the mercury immediately leaves the tube F and the vessel B, and remains suspended in A at a height of thirty inches above the mercury in C; the small vessel G will obviously remain full of mercury. On removing the bladder from E the column of mercury in A immediately subsides, and mercury rises in F until it stands at H, a height of thirty inches above the surface of the mercury in the vessel G.

Many of the vacuum experiments described in the Proceedings of the Society were made in the Torricellian vacuum; but the air-pump was also used. Some of the experiments of this nature relate to the behaviour of birds and animals in rarefied air. Fishes were placed in a receiver, in a vessel of water; on exhausting, they swelled out considerably, turned over, and quickly died, when dissected the air-bladder was found to be empty. An eel lived for some time in vacuo, but was found to be dead at the end of an hour; the air-bladder, as in the case of the fish, was empty.

Pascal found that a bladder partially inflated at the level of the sea became wholly inflated on the summit of a mountain. Robervall made the same experiment with a carp's bladder, which burst when placed in the Torricellian vacuum. This suggested to some of the members of the Academy the idea that the expansion of air, "when at absolute liberty in any place," might be determined by annulling the atmospheric pressure by the weight of a column of mercury below the air, the expansion of which it is desired to determine. Accordingly, two similar tubes, open at one end, and terminated at the other by a bulb, were filled with mercury: one was inverted and opened under mercury in the usual way of performing Torricelli's experiment; into the other a small quantity of air was introduced before the tube was inverted; by calculation it was found that the air had expanded to 173 times its original bulk, but the experiments were not very concordant.

I may mention in passing that the experiment proving the incompressibility of water, by causing it to force its way through the pores of a metal, which is universally attributed to the Accademia del Cimento, was performed many years earlier by Bacon,\*\* who used a sphere of lead for the purpose, while the academicians employed a sphere of gold.

In the next paper we shall consider the early labours of the Royal Society and of the Academie des Sciences relative to the subject under discussion.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

*Anniversary Meeting, Thursday, March 30.*

*Professor A. W. WILLIAMSON, Ph.D., F.R.S., President, in the Chair.*

IN an able address the President sketched the history of the Society's proceedings during the past year, referring to the satisfactory condition of its finances, and the gradually increasing number of its members. At the present time the Society was composed of 453 Fellows, 38 foreign Members, and 6 Associates. The papers read during the past year were enumerated, and their number amounted to 32. The success of the Journal had been considerably augmented by its more frequent publication, and by the more valuable nature of its contents. The Society had to

deplore the loss by death of four members during the year; their names and qualifications were described by the President. The late Dr. Robert Dundas Thomson was well known as the Officer of Health for Marylebone,—a post which he held for several years with honour to himself and in the exercise of duties of undoubted usefulness. Mr. James Beaumont Neilson, F.R.S., of Castle Douglas, N.B., was the eminent inventor of the hot-blast, and of other improvements in the manufacture of iron. Dr. Alphonse Normandy was by birth a Frenchman, who, having studied and graduated abroad, ultimately adopted London as his place of residence. His works on analytical chemistry had contributed to his reputation, but his crowning effort was the invention of an apparatus for distilling and aerating water on board ship, which appeared to be now in general use in Her Majesty's navy. Dr. Thomas Pugh, late of the Agricultural College of Pennsylvania, U.S., was better known in this country in connection with the Rothamsted laboratory, where some years ago he made a valuable series of experiments, in conjunction with Mr. Lawes and Dr. Gilbert, on the assimilation of nitrogen by plants. Dr. Pugh's quantitative method of estimating nitric acid was known to be one of the most accurate and practically available of the processes described for this purpose. The Treasurer, Dr. Warren De la Rue, then presented his financial statement, and compared the state of the funds at this date, when the assets were 1889*l.* 18*s.* 11*d.*, with the 150*l.* Consols and 150*l.* balance in the hands of the bankers, which represented the whole fortune of the Society at the time of his accepting office eight years ago. The increased receipts for 1864-5 enabled him to buy in 100*l.* Consols during the present year. The greatest items of expenditure were:—

Publication of the Society's Journal . . .	418 <i>l.</i>
Proceedings of the Royal Society . . .	50 <i>l.</i>
Purchase of books . . . . .	36 <i>l.</i>
Household expenses . . . . .	48 <i>l.</i>

The balance-sheet having been audited, was ordered to be suspended.

The TREASURER offered a suggestion which he hoped would diminish the difficulty of levying arrears. In estimating the losses a sum of 80*l.* had been written off for bad debts; and to meet these cases in future an alteration of the fourth bye-law was proposed, the practical effect of which would limit to two years, instead of three, the interval which must be allowed to elapse before the payment of arrears can be enforced or steps taken in default.

Dr. De la Rue's proposition having been put to the vote was carried unanimously.

The ballot was then taken for the election of officers for the year ensuing, and Dr. Attfield and Mr. Duppa were appointed scrutators. These gentlemen reported that the votes had carried the election of the under-mentioned officers:—

*President*—W. A. Miller, M.D., F.R.S.

*Vice-Presidents, who have filled the office of President*—W. T. Brande, F.R.S.; Sir B. C. Brodie, F.R.S.; C. G. B. Daubeny, M.D., F.R.S.; Thomas Graham, F.R.S.; A. W. Hofmann, Ph.D., LL.D., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; A. W. Williamson, Ph.D., F.R.S.; Colonel Philip Yorke, F.R.S.

*Vice-Presidents*—Walter Crum, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; John Stenhouse, LL.D., F.R.S.; Robert Warington, F.R.S.

*Secretaries*—William Odling, M.B., F.R.S.; Augustus Vernon Harcourt, Esq.

*Foreign Secretary*—E. Frankland, Ph.D., F.R.S.

*Treasurer*—Theophilus Redwood, Ph.D.

*Other Members of Council*—F. A. Abel, F.R.S.; G. B. Buckton, F.R.S.; Dugald Campbell; H. Debus, Ph.D., F.R.S.; B. F. Duppa; G. C. Foster; E. A. Hadow; J. B. Lawes, F.R.S.; Hugo Müller, Ph.D.; W. J. Russell, Ph.D.; Maxwell Simpson, M.B., F.R.S.; C. Greville Williams, F.R.S.

\*\* See "Novum Organum." Book 2, Aph. 45.



A vote of thanks to the retiring officers was proposed by Dr. A. W. HOFMANN, seconded by Dr. FRANKLAND, and, after a few complimentary words from Dr. BACHHOFFNER, carried unanimously. It was stated that the post of secretary had been held by Dr. Redwood during a period of fifteen years. The retiring PRESIDENT briefly acknowledged the expression of thanks and approbation, and then adjourned the meeting until 6th April.

## ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 17, 1865.

*On the Latest Discoveries concerning the Sun's Surface.*

By BALFOUR STEWART, F.R.S.

OUR moon, it is well known, is almost as correctly mapped as our own globe, so that an astronomer, could he be transported to the surface of our satellite, would arrive there prepared to expect a certain appearance; and on his arrival he would not probably be much surprised. But could such an one be transported to the surface of our luminary his case would be very different; for he would arrive there hardly knowing what to expect. He might not be sure in his own mind whether or not the luminous matter would prove to be composed of a number of distinct bodies, like willow-leaves, whether the spots would be found to be hollow in this luminous matter, or whether they would prove to be clouds floating above it. The cause of this uncertainty is twofold. First of all, it is due to the circumstance that a distant body such as the sun or moon does not impress us with the idea of relief. The disc of such a body appears quite flat, and the mountains of the moon are only distinguished from the valleys by a difference of shading. This absence of the idea of relief is due to the distance of these bodies.

If we hold a small cube of wood very near the eye, shut the right eye, and view the cube, then shut the left eye and do the same, evidently the cube presents a different appearance to each eye; and it is this difference that enables one, when both eyes are used, to obtain the idea of relief. But if this cube be a very great distance off it will appear nearly the same to both eyes, and the idea of relief will not be obtained. Thus, for example, a distant mountain does not stand out like the nearer parts of a landscape because our eyes are not far enough apart to give that difference of position which is necessary; and it has been well remarked by Sir J. Herschel that the moon would appear spherical and full of mountains to a giant whose eyes were thousands of miles apart, while to ordinary mortals it merely appears a flat disc. We can, however, by putting together two pictures of the moon or of the sun, taken at different times, produce a stereoscopic representation of these bodies. This has been done by Mr. De la Rue for the moon with great success, and also for the sun in less numerous instances.

The present knowledge which we possess of the surface of our luminary is not, therefore, derived from the idea of relief given naturally, and only to a certain extent from stereoscopic representations, but it is to a considerable extent derived from a careful study of sun pictures; and this leads to our second difficulty. Long before the invention of the stereoscope, it was known quite well what parts of the moon's surface were mountains and what hollows; for it was comparatively easy to argue regarding a set of phenomena which do not differ very greatly from those which belong to the surface of our earth; but the phenomena in our sun are so entirely different from any that we experience, and, perhaps, from any that we can conceive, that we must be exceedingly careful in our conclusions regarding them in order that we may not be misled. We must throw away all speculation and all hypothesis, and submit to be guided by observation alone. The luminous disc, or surface of the sun, which we see is termed its photosphere; and our whole inquiry may be

divided, with reference to this bounding surface, into three parts, the first relating to the region above the photosphere, the second to the photosphere itself, and the third to the region below the photosphere.

To commence with the region above the photosphere, it is easy to show that it contains a very dense atmosphere, which is of a comparatively low temperature. In the first place, according to a well-known law, the dark lines in the solar spectrum denote the presence of certain substances in a state of vapour, and yet in a comparatively cold state above the photosphere of the sun. These substances comprise, among others, sodium, magnesium, iron, and nickel. Another proof of the existence of a solar atmosphere is that the light, more especially the actinic light, from the border is less intense than that from the centre of the disc; this is due to the fact that light from the border has to pierce through a much greater depth of atmosphere than light from the centre, and hence a great portion of the light from the border will be absorbed by this atmosphere if it be colder than the source of light. (This was exhibited by means of a photograph of Mr. De la Rue's.) The last proof of an atmosphere is that derived from the picture of the sun taken during a total eclipse.

When the sun is totally eclipsed there is not yet total darkness. There is, in the first place, a glory or corona round his disc, and in the second there are curiously-shaped bright bodies round him called red flames, and sometimes red protuberances. It appeared to the Astronomer Royal and some others that it was probable that these bodies belong to the sun, but the thing was put beyond doubt by Mr. De la Rue, who, by means of the Kew heliograph, was enabled to take photographic pictures of the sun at the total eclipse which happened in Spain in July, 1860.

These photographs (which were exhibited) showed that as the moon proceeded over the sun's disc the red flames and part of the corona discovered themselves at that side which she had left, and were covered up by her disc at that side towards which she was approaching; thus showing that they belonged to the sun. Another proof in favour of these bodies belonging to the sun is derived from the nature of the light which they emit. This light was found to have great photographic power compared to its luminosity; so much so, that one prominence was photographed by Mr. De la Rue that was invisible to the naked eye. Now such rays, as far as we know, can only belong to intensely heated gas, and intensely heated gas can only belong to the sun. Next, with regard to the photosphere, the first thing to be noticed is the fact that this surface is not a smooth, uniform, continuous surface. When it is viewed through powerful glasses it appears granulated or mottled. (Reference was made to a large diagram kindly lent by the Rev. F. Howlett.) But this is not all; there is reason to believe that great magnifying and defining power shows us something more, although it is very difficult to see it. Mr. James Nasmyth was the first to proclaim the curious fact that the whole photosphere of the sun is made up of detached bodies interlacing one another, and preserving a great amount of regularity both in form and size; he called them willow-leaves, Mr. Stone has called them rice-grains, Father Secchi coups-de-pinceau. (Here some pictures taken by Mr. Nasmyth were exhibited.) It would be a speculation much beyond our power to conjecture what it is that gives these bodies the astonishing regularity of form.

In connection with this part of the subject, attention should be directed to the brighter portions of the photosphere, or faculae as they are sometimes called. It is chiefly near the limb of the sun that these relatively bright portions of the sun's disc appear; for when they come to the centre the difference in brightness between them and the surrounding parts of the disc is not so easily traced. Now, the reason of their great brightness is believed to be



this—they are portions of the sun's photosphere thrown up into the higher regions of the atmosphere. This enables them to escape a great portion of the absorbing effect by this atmosphere, which, as has been shown, is particularly strong near the border; and hence when there they appear much brighter than the surface around them; but near the centre the absorption is not great, so that they do not *gain much* by escaping it. The idea that these faculae are elevations has been confirmed by a stereoscopic impression of a sun spot and some faculae taken by Mr. De la Rue, and in which, while the spot appears to be a hollow, the faculae appear as elevated ridges. It thus appears that the faculae are elevated; but further they retain the same appearance often for a considerable time, sometimes even for days together; so that faculae are not composed of heavy matter, otherwise they could not remain elevated; and hence the faculae as well as the photosphere, of which they are only the most elevated parts, is not composed of heavy matter such as a molten sea, but is rather of the nature of a cloud.

The phenomena of the third region or that below the photosphere may be comprehended in one word—sun spots. These consist of an umbra or central darkness, surrounded by a less dark penumbra. Mr. Dawes has discovered in some spots even a deeper darkness in the centre of the umbra. Now, if it be correct to suppose that spots are cavities, of which the umbra forms the bottom and the penumbra the sloping sides, then the umbra ought to encroach on that side of the penumbra which is next the visual centre of the disc. Professor Wilson, of Glasgow, was the first to remark that spots really behaved in this manner; and his remark has been abundantly confirmed by the Kew photographs taken under the superintendence of Mr. De la Rue. (One of these was exhibited, showing the phenomenon.) It, therefore, follows that the umbra of a spot is at a lower level than the penumbra; and since luminous ridges and sometimes detached portions of luminous matter cross over spots, it must be concluded that the whole phenomenon is below the surface.

Again, spots exhibit the rotation of our luminary. If we turn to the south and view the sun, spots always cross the disc from east to west—that is to say, from left to right. (The apparent path of a spot at different seasons was here traced on a diagram lent by the Rev. F. Howlett, and it was remarked that when allowance is made for the inclination of the earth's axis the path is really the same at different seasons.) Besides the apparent motion, due to rotation of the sun, spots have also a proper motion of their own, first observed by Mr. Carrington; this motion is also from left to right, those near the solar equator moving fastest. Mr. Carrington also remarked that spots confine themselves to the equatorial regions of the sun.

Hofrath Schwabe, of Dessau, has remarked that spots have a period of maximum and minimum nearly every ten years, and General Sabine has found that the year of maximum sun spots is at the same time that of greatest disturbance of the earth's magnetism.

Finally the behaviour of sun spots appears to some extent to be influenced by the planet Venus in such a manner that when a spot comes round by rotation to the ecliptical neighbourhood of this planet it has a tendency to dissolve, and, on the other hand, as the sun's surface recedes from this planet it has a tendency to break out into spots.

#### ACADEMY OF SCIENCES.

March 27, 1865.

M. C. ST. CLAIRE DEVILLE read the first part of his memoir "*On the Probable Influence of the Appearance of Asteroids on the Temperature of the Air.*" The author at starting quoted the opinions of other astronomers and meteorologists who have shown that at the periods when aste-

roids are most numerous, notable perturbations in the temperature at the surface of our globe occur. From a review of the observations made in Paris during the fifty-seven years 1806-1863, M. Deville showed a diminution of temperature occurred from the 10th to the 15th of February, and from the 10th to the 16th of May. From the 11th to the 15th of August there would, on the contrary, appear to be a slight elevation of temperature. On the days of the maximum appearance of asteroids in November, 13th to 16th, the influence is less clear. There would seem to be a decrease at first, and subsequently an elevation. The observations detailed in the paper are of the greatest interest to meteorologists, and will, no doubt, attract great attention. We may quote one paragraph which shows the fallacy of calculating averages from insufficient data. The mean temperature of February 1 in Paris, deduced from the observations of the ten years 1829-1839, is 1.43; calculated from observations in the ten years 1843-1853 it will be 5.30.

A note by M. P. Gervais, "*On the Application of the Electric Light for Illumination under Water,*" suggests the use of a battery and coil in a water-tight box, and a Geissler's carbonic acid tube. Rhumkorff has made the author such an apparatus, which has been quite successful. It acted well under water for six hours.

M. Cahours presented a long note "*On Organic Radicals,*" in which he described some new compounds of sulphur and tellurium with ethyl and methyl, the means by which they were obtained, and their general properties.

M. Gaultier de Claubry presented a note "*On New Solvents for Aniline Colours.*" The author experimented to find cheap substitutes for alcohol and wood spirit, and discovered that a decoction of soap bark, or of Egyptian soap root, will dissolve the colours and yield solutions very convenient for dyeing and printing. One advantage of these solutions, it seems, is that they give uniform shades.

M. Hoffmann sent from Giessen a note "*On the Vegetable Nature of Yeast,*" which we believe was satisfactorily decided before M. Hoffmann began his experiments.

#### NOTICES OF BOOKS.

*The Retrospect of Medicine; being a Half-Yearly Journal containing a Retrospective View of every Discovery and Practical Improvement in the Medical Sciences.* Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. L.—July to December, 1864. London: Simpkin, Marshall, and Co. 1865.

WE need only announce the title of this book, so useful to medical practitioners, and say that the present volume worthily sustains the character of its predecessors.

*Stammering and Stuttering: their Nature and Treatment.* By JAMES HUNT, Ph.D., &c., &c. Sixth Edition. London: Longman and Co. 1865.

WE hardly know why this book is sent to us. Chemists do not usually stutter. It would be very awkward if they did, seeing they have at times to get out such words as *methylethylamylophenylum*. If, however, any one should find a difficulty in enunciating this polysyllabic monstrosity, we have no doubt he might advantageously put himself for a time under Dr. Hunt's treatment, which, to our own knowledge, is very successful in removing impediments of speech.

*Bulletin de la Société de Chimie de Paris.* March, 1865.

THE proceedings of the Chemical Society of Paris at the two sittings here reported, offer very little of interest, most of the papers, as usual, having already been noticed in the proceedings of the Academy of Sciences. We give in another place a note by M. Gal on the action of sodium



on carbonic ether, and a new process for the preparation of benzoic acid by MM. P. and E. Depouilly. We have given some account of the latter paper before; but as the subject is of some commercial as well as scientific importance, we shall give the entire paper.

The abstracts from foreign journals in this number of the *Bulletin* are, as usual, numerous and complete.

*Chemisches Central Blatt.* Nos. 8, 9, 10.

NUMBER 8 contains an article by M. Alsberg "*On Acetals*," in which the author shows that by heating the aldehyd with several volumes of an alcohol bodies homologous with acetals may be obtained. The author has in this way formed diamylacetal, dimethylacetal, diethylrateral, dimethylerateral, &c. There is also a paper by Reichardt "*On a New Mode of Obtaining Monohydrated Oxalic Acid*." The author dissolves the ordinary acid in concentrated sulphuric acid, from which solution, after a time, the monohydrate crystallises out. The first crystals which form are the ordinary terhydrate; then a bihydrate separates; and, lastly, after a week, small rhombic octohedral crystals of  $C_2O_3.HO$  deposit. They quickly attract moisture, and must be isolated and dried with great care. The abstract of a paper by Brande "*On the Chemical Composition of Tobacco Leaves*" announces the presence in them of malic, citric, and oxalic acids. A short notice of a process for preparing chloride of platinum we transfer to our pages in another place, as well as a method of removing empyreumatic oils from acetic acid by Frederking.

Numbers 9 and 10 contain an original communication from Dr. Heiden, entitled "*A Contribution towards Explaining the Cause of Absorption by Soils*." The principal agents concerned in the fixation of alkalies in the soil are, according to the author, hydrated silicates; but we shall give the whole of his conclusions in an early number. In Number 9 we have also an announcement by Professor Reichardt "*Of the Formation of Oxalic Acid by the Action of Oxide of Copper on Milk Sugar in the Presence of Free Alkalies*." To effect this reduction, the use of a relatively large proportion of copper salt is necessary. With one part of milk sugar and six parts of acetate of copper, the author obtained 8.1 per cent. of oxalic acid. By some "*Chemical Researches on Red Coral*," Shaper has shown that the colour of red coral is entirely owing to the presence of anhydrous peroxide of iron. Benzol, ether, &c., extract a yellow resinous substance without changing the colour of the coral. Brandl and Rakowiecki have made an *analysis of beechnuts*, in which they find 45 per cent. of a fatty oil, a caseine-like substance, resin, starch (3 per cent.), gum, sugar, citric and oxalic acids, tannin, and an infinitesimal quantity of a volatile alkaloid—trimethylamine.

## NOTICES OF PATENTS.

1540. *Dyeing and Printing.* C. A. MARTINS, Warrington. Dated June 21, 1864.

THE patentee produces black, brown, and drab colours upon linen and calico by padding or printing upon these fabrics with a salt of phenylenediamine, and afterwards exposing the moist surfaces to the action of ammonia. The tint of colour produced can be modified by varying the strength of the solutions, and by using mixtures of phenylenediamine with any of its homologues.

1545. *Apparatus for Manufacturing Sulphate of Ammonia and Sulphuric Acid.* J. FORBES, Old Ford, Bow. Dated June 21, 1864.

IN the production of sulphate of ammonia by saturating dilute sulphuric acid with gas-tar liquor it is well known that much sulphuretted hydrogen is evolved; in order to get rid of this objectionable product and economise the

sulphur which it contains, the fumes are burnt, and the sulphurous acid formed is conducted into leaden chambers for the purpose of being converted into sulphuric acid.

1538. *Obtaining Sulphuric Acid from the Refuse Pickle used in Tinplate Works, and also from the Sulphate of Iron or Green Copperas.* W. J. PUGHSLEY, Christchurch, Monmouthshire. Dated June 21, 1864.

THE method of treatment specified by the inventor consists in evaporating down the refuse liquid and allowing the green vitriol for the most part to crystallise out; the excess of sulphuric acid always present in the mother liquor may then be economised by employing it in its more concentrated form for the cleaning of fresh iron surfaces, whilst the crystals of green vitriol are submitted to distillation in retorts for the purpose of furnishing sulphuric acid according to a well-known principle on which the Nordhausen acid is usually manufactured.

## GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by MR. VAUGHAN, PATENT AGENT, 54, CHANCE LANE, W.C.

549. W. Sim, Glasgow, N.B., "An improved method of extracting gases from mineral oils, and in employing the same for illuminating and heat producing purposes, and in the machinery or apparatus connected therewith."—Petition recorded Feb. 27, 1865.

590. W. E. Newton, Chancery Lane, "An improved process and apparatus for impregnating wood with chemical solutions."—A communication from E. Bazin and J. Hémerly, Paris.—March 2, 1865.

606. J. H. Johnson, Lincoln's Inn Fields, "Improvements in stopping bottles."—A communication from N. B. Goodyear, New Haven, Conn., U.S.A.—March 4, 1865.

624. F. Cruickshank, Edinburgh, N.B., "Improvements in coatings for the prevention of the fouling to which iron and other ships and structures are ordinarily liable in sea water."

630. G. Nimmo, Jersey City, N.I., U.S.A., "Improvements in the manufacture of crucibles and pots in which metals or other substances may be melted."—March 6, 1865.

646. G. Ireland, Handsworth, Staffordshire, "Improvements in stoppers for closing bottles, and for other like purposes."—March 8, 1865.

478. J. Cliff, Wortley, near Leeds, "An improvement in the utilization of the waste gases of blast furnaces."—Feb. 20, 1865.

591. C. Rahn, Brook Street, Grosvenor Square, "An improved instrument for concentrating light, applicable to dental, surgical, and other operations."—March 2, 1865.

599. R. A. Brooman, Fleet Street, London, "Improvements in refining sugar and in apparatus employed therein." A communication from A. Guillon, Nantes, France.—March 3, 1865.

617. A. Akeroyd, Bradford, Yorkshire, "An improved process and apparatus for dyeing and preparing cotton, worsted, and silk warps."—March 4, 1865.

631. W. Clark, Chancery Lane, "Improvements in preparing or treating hides for tanning." A communication from W. Martz, Boulevard Saint Martin, Paris.—March 6, 1865.

636. L. Perkins, Francis Street, Gray's Inn Road, "Improvements in apparatus for heating and cooling atmospheric air and other aëriiform bodies, and for heating ovens, and for heating and ventilating buildings."—March 7, 1865.

645. A. C. Henderson, Charing Cross, "An improved method of preserving meat." A communication from H. F. Méressart, Paris.

649. M. Morgans, Brendon Hills, Somersetshire, "Im-



improvements in converting cast-iron or pig iron into wrought iron or steel, and in machinery employed therein."—March 8, 1865.

657. R. Mushet, Cheltenham, Gloucestershire, "Improvements in the manufacture of steel and homogeneous iron."

666. J. Cliff, Wortley, near Leeds, "An improvement in the construction of hot-air stoves for blast furnaces."

668. G. F. Ansell, Bernard Street, Russell Square, "An improved mode of, and apparatus for, ascertaining and indicating the presence of explosive gases."—March 9, 1865.

692. E. B. Wilson, Glasgow, N.B., "Improvements in furnaces and fire-places."—March 11, 1865.

700. J. Wright, Dudley, Worcestershire, "Improvements in puddling, heating, and other furnaces."—March 13, 1865.

717. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in apparatus for vaporising hydrocarbon liquids for illuminating and heating."—A communication from J. Griffen, Meridan, Conn., U.S.A.

719. A. V. Newton, Chancery Lane, "Improvements in securing low and uniform temperatures, applicable to public and private buildings, also to refrigerators, coolers, and condensers, and to ships and other vessels, and in the apparatus employed therein."—A communication from D. Somes, Washington, U.S.A.—March 14, 1865.

730. J. F. Brinjes, Fieldgate Street, Whitechapel, "Improvements in apparatus for cooling animal and other charcoal."

732. C. Morfit, Avenue de l'Imperatrice, Paris, "Improvements in heating and purifying oils and fats."—March 15, 1865.

765. J. C. Stevenson, South Shields, "Improvements in the preparation of hyposulphite of lime."—March 18, 1865.

777. R. T. Crawshay, and J. A. Lewis, Cyfarthfu Iron Works, Glamorganshire, "Improvements in the manufacture of puddled iron bars and every description of malleable iron."—March 20, 1865.

805. J. Wright, St. Paul's Crescent, "Improvements in the process of preparing Kaolin or China clay and other clays for potters' use, and for expelling water from other earthy deposits." A communication from J. Muir, New York, U.S.A.—March 22, 1865.

#### NOTICES TO PROCEED.

2852. A. Wall, Clapton, "An improved combination or improved combinations of materials to be used as fuel."—Petition recorded Nov. 15, 1864.

2883. A. A. Croll, Coleman Street, London, "Improvements in the preparation of materials to be used in the purification of gas for illumination."—Nov. 18, 1864.

2920. G. M. de Bayelt and J. E. Vigoulète, Nelson Square, Surrey, "An improved method of compounding, by agglomeration, artificial fuel."—Nov. 23, 1864.

2969. M. A. F. Menuous, Westminster, "Improvements in hot blast furnaces." A communication from N. de Telescheff Ofitserkaia, St. Petersburg.—Nov. 29, 1864.

630. G. Nimmo, Jersey, U.S.A., "Improvements in the manufacture of crucibles and pots in which metals or other substances may be melted."—March 6, 1865.

**Metropolitan Sewage.**—A committee of the House of Commons has reported in favour of the scheme of Messrs. Hope and Napier,—a scheme which has always appeared to us, in spite of the protestations of Baron Liebig, to offer the most reasonable prospect of the profitable disposal of the sewage. We have said before also that Mr. Ellis's plan might have a trial simultaneously if capitalists will come forward with the necessary money. The sewage of one district would be quite sufficient for an experiment.

## CORRESPONDENCE.

### Continental Science.

PARIS, April 3.

My letter last week was unavoidably curtailed, or I intended to give an account of some applications of liquid ammonia by M. Tellier, of whose ammoniacal horses I have before spoken. These applications are founded upon two indisputable truths:—1. In empty spaces liquids spontaneously give off vapour, the tension of which immediately reaches its maximum. 2. In two spaces communicating, kept at unequal temperatures, and containing one liquid, there is always evaporation in the warmer space and condensation in the colder. The first application suggested is a means of cooling the air of the saloon and cabins of a steamer, say going down the Red Sea, where the want of cool air is generally experienced. For this purpose he puts liquid ammonia in a sort of tubular boiler, the tubes of which are in free communication with the air and the saloon to be cooled, while the boiler itself is in communication with a worm and receiver bathed with a stream of cold water. The warm air as it passes through the tubes parts with its caloric to vaporise the ammonia, and so reaches the cabin delightfully cool, while the ammonia goes on to the receiver to be again condensed. On its way it is utilised to drive a ventilator, supply cold water to the receiver, and pump itself back again to the generator; but by what contrivances and machinery is not stated. A modification of the same plan, as M. Tellier states, is also adapted to cool theatres and other places of entertainment, as well as ships' cabins. More ingenious still is the idea of making the solar rays volatilise ammonia, and so in parching heats manœuvre a pump or pumps which shall irrigate the thirsty earth with refreshing streams, and so make the sun partially undo its own work. More practicable, perhaps, is the idea of using the liquid ammonia to cool the wort in breweries and maintain a constant temperature during fermentation. Remember that all these ends are to be effected without loss of material, and give M. Tellier the credit of being one of the greatest inventors or most ingenious theorists of modern times.

M. Maistre, I may tell you, has published here suggestions for an alarum thermometer, closely resembling, I believe, one imagined by your correspondent, Mr. Wentworth Scott. It is to be connected with magnetic apparatus which is to open and shut ventilators, and regulate the temperature of an apartment without the intervention of human agency. The contrivances for this are very easily imagined, but have never, that I remember, been put in practice.

A Portuguese naval officer with a long name, one José de Menna Apparicio, has proposed a new constant battery for telegraphic purposes. It is a modification of those of Marie-Davy, and Minotto. The electrodes are zinc and carbon, but in place of sulphate of copper the author uses sulphate of mercury. A cylinder of carbon is fixed in a disk of the same substance, which rests upon and is covered by a layer of the sulphate at the bottom of the cell. To give a large extent of surface zinc bands are twisted in the form of a spiral. The cell is filled up with moist sand. An electrician will easily see how the connections are established. The author says the battery is both cheap and constant.

I see a way of preserving potatoes described which may be useful to some of your readers. At the bottom of a dry floor a few inches of straw is laid, upon this a layer of potatoes 12 or 15 centimetres deep is placed, which is dusted over with plaster of Paris; more straw is then put, and again a layer of potatoes, and so on for eight or ten layers. When preserved in this way it is said the tubers never sprout.

The decimal system would seem to be spreading here. Few people will use decimal weights in ordinary commerce



if they can help it, and only use a decimal coinage because they have no other. Nevertheless, M. Cacheleux has brought out a decimal time piece and watch. He divides the day into ten hours, the hours into 100 minutes, the minutes into 100 seconds, and these last into 100 *thirds*. The dials are marked with the ordinary divisions as well, so people may consult which style they please. No doubt astronomical and nautical calculations might be simplified by the change suggested, which a married lady tells me is further recommended by the circumstance that if it were once adopted nobody could ever again stay away from home so late as twelve o'clock.

A very ingenious direct vision spectroscope has been devised by M. Hoffmann, the optician here. The pocket instrument is a straight tube containing five prisms so arranged that the rays pass in and out in a straight line, and the objective is placed between the prisms and the slit.

#### Professor Wanklyn's Paper on Vapour Densities.

To the Editor of the CHEMICAL NEWS.

SIR,—From the letter which Professor Wanklyn addressed to you last week, I perceive that the author is not well satisfied with the report or abstract of his communication which appeared in the CHEMICAL NEWS of 24th March. My duty as reporter was an easy one; for having in this instance the advantage of comparing my notes with the original manuscript, and finding, moreover, the greater part of the author's statement already in print as an earlier communication to the Society, I am not prepared to admit the force of Professor Wanklyn's objection.

Your readers will in due course have an opportunity of comparing the author's original with my transcript; unless, indeed, the want of novelty in the said communication should stand in the way of its appearing once more in the Annals of the Society.

I am, &c.,

THE REPORTER.

April 3.

### MISCELLANEOUS.

**The Chemists' and Druggists' Bills.**—These two bills have, as we expected, been referred to a select committee of the House of Commons. In the debate on the second reading, Sir George Grey advocated the course we have recommended,—namely, a fusion of the two bills. He contended that the retail trade in medicines needed supervision, and urged the necessity of some provision respecting the sale of poisons.

**Public Schools' Bill.**—We are sorry to see that this extremely mild but promising measure has been referred to a Select Committee of the House of Lords. The simple proposal to place men eminent in science on the governing boards of such institutions as Eton, Harrow, and Rugby Schools appears to have been sufficient to excite the opposition of a man so liberally inclined as Dr. Temple. There would seem to be little hope of establishing in these institutions a system of education adapted to the nineteenth century.

**Royal Institution.**—This evening, Friday, April 7, Dr. A. W. Hofmann, F.R.S., "On the Combining Power of the Atoms of the Elements."

**Preparation of Chloride of Platinum.**—Böttger first fuses platinum with three times its weight of lead, powders the alloy, and then digests in nitric acid to remove the greater part of the lead. He then dissolves the residue in aqua regia, evaporates to dryness, dissolves in water, filters, and decomposes the filtrate with a slight excess of carbonate of soda, whereby he precipitates the remaining lead, and obtains a platino-chloride of sodium, which can be used at once to precipitate rubidium, cesium,

thallium, &c. To recover the platinum from the washings, he boils these with a large excess of carbonate of soda and some glucose until the mixture blackens. By supersaturating now with dilute sulphuric acid, and heating for a time, the platinum quickly separates quite pure.

**Ozone and Antozone.**—We have endeavoured in vain to find a confirmation of the statement that Schönbein had succeeded in isolating the opposite conditions of oxygen. The last published volume of the Proceedings of the Royal Academy of Munich, to which we were referred, contains no paper by Schönbein. We doubted the truth of the intelligence when we announced it, for it would have been strange if the news of such a discovery had not spread over Europe with the speed of lightning.

**Removal of Empyreumatic Oils from Pyroligneous Acid.**—Frederking, treats two gallons of acetic acid with nine drachms of bichromate of potash and three drachms of sulphuric acid, allows the mixture to stand twenty-four hours in the cold, and then distils off the acid to within a few ounces.

**Dalton's Thermometer.**—At a recent meeting of the Manchester Literary and Philosophical Society, Mr. Baxendell stated that the Society had in its possession a thermometer constructed by the late Dr. Dalton, and which, it is believed, was used by him in many of his meteorological observations. The scale had the initials "J. D." and the year "1823" engraved upon it; and the freezing and boiling points of water are indicated on the stem by fine file marks. As it is known that the zero points of thermometers sometimes change to the extent of one or even two degrees in the course of several years, it occurred to Mr. Baxendell that it would be interesting to ascertain whether any change had taken place in this thermometer, and he had therefore lately tested very carefully the position of the freezing point, but found that no sensible alteration had taken place; and he believed therefore that great confidence might be placed in the observations which Dalton had made with this instrument.

### ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

J. J., Jun.—The experiment suggested has been made.

W. V. R. (Leamington).—Such communications are always acceptable.

Juvenis.—You should use a dilute acid. One part to three of water is sufficiently strong.

X.—The best red sealing wax dissolved in spirit.

Inquirer must consult the records of the Patent Office. Several patents have been taken out for similar processes.

Calor.—An abstract of the papers will appear shortly.

A. C.—Arrangements are being made for them.

C. E. Goessman.—Letter received, but not pamphlet. All the corrections marked on the last copy were attended to.

F. II.—We forgot to mention last week that an account of Holmes' magneto-electric apparatus will be found in No. 15, Vol. I, of the CHEMICAL NEWS.

Received with thanks.—R. Campbell, Montreal, Canada; A. H. Church; John Newlands, F.C.S.

Books Received.—"The Applications of Geology to the Arts and Manufactures," by Professor D. T. Ansted, M.A., F.R.S.

Erratum.—No. 278, page 156, second col., line 36, for "blue oxide," read "black oxide."







These latter reactions are particularly significant, for it cannot be comprehended how a body saturated with oxygen can reduce another in the same condition, unless the oxygen of the one possessed a certain affinity for the oxygen of the other.

M. Schönbein considers that oxygen is a combination of negative and positive oxygen; so far his opinion is strengthened by the observations just mentioned, but when he supposes that negative oxygen  $\ominus$  constitutes in the free state ozone, and that positive oxygen  $\oplus$  in the free state constitutes the body which he names antozone, he advances a hypothesis ingenious but gratuitous, for he has given no explanation of it. He has rather put himself in opposition to known facts. Messrs. Andrews and Tate have indeed demonstrated that ozone is condensed oxygen $\S$  and the most rational interpretation of their experiments is to admit with Dr. Odling $\parallel$  that ozone consists of oxygenated water,  $\text{H}_2\text{O}_2$ , in which the hydrogen is replaced by an equivalent quantity of oxygen. The recent experiments of M. Soret $\P$  seem to confirm this manner of viewing it.

But to return to molecular weight. The arguments which have just been discussed appear to me to strengthen this important proposition, that two atoms of certain simple bodies can combine with each other to form one molecule. Here is another argument which strengthens this hypothesis, drawn from another order of facts. It is known that the radicals of organic chemistry may be considered in certain respects as the analogues of the elements in mineral chemistry. What, then, will happen when, in iodide of ethyl, the iodine is separated from the radical ethyl  $\text{C}_2\text{H}_5$ ? This will combine with itself to form what has been named free ethyl,



Let us recall here that MM. Favre and Silberman, in their classical researches on the heat evolved in chemical combination, were the first to suggest that the molecule of free oxygen is formed of two atoms.\*\* On the other hand, it is known that M. Clausius has been led by mechanical considerations on the constitution of gases to admit "that the force which governs chemical combinations, and which probably consists of a kind of polarity of the atoms, exerts itself even between simple bodies, and that in these latter several atoms may combine into one molecule."

The most simple case, and consequently the one most likely to be true, says he, will be that in which two atoms form one molecule. Thus, in the case of oxygen or nitrogen, it may be imagined that the chemical force which resides in one atom is exerted on a second atom in a molecule of these gases. $\dagger\dagger$

(To be continued.)

$\S$  *Annales de Chimie et de Physique*, 3rd series, vol. lii., p. 333, and vol. lxii., p. 101.

$\parallel$  "A Manual of Chemistry," by W. Odling. 1861. p. 94.

$\P$  "On the Volumetric Relations of Ozone."—*Bibliothèque Universelle et Revue Suisse*, vol. xviii., September, 1863.

\*\* *Comptes Rendus*, xxiii., 200, 1846, MM. Favre and Silberman have proved that carbon when burnt in protoxide of nitrogen evolves more heat than when burnt in oxygen. According to them the most natural interpretation of this fact consists in admitting that, in each experiment, a chemical combination is destroyed whilst another is formed; and that the thermic effect produced is the difference between the amount of heat disengaged by the union of carbon with oxygen and the amount of heat absorbed by the decomposition of oxide of oxygen in the first instance, and of oxide of nitrogen in the second. And if the thermic effect is less for oxygen than with protoxide of nitrogen, that is due to the circumstance that oxide of oxygen (the molecule of oxygen  $\text{OO}$ ) absorbs more heat in decomposing than does the molecule of protoxide of nitrogen.

$\dagger\dagger$  *Poggendorff's Annalen*, c. 369; and *Annales de Chimie et de Physique*, 3rd series, l. 505.

*On the Calorific Phenomena which Accompany the Formation of Organic Compounds,\** by M. BERTHELOT.

THE author proposes to inquire what are the calorific phenomena which govern the formation of organic compounds, or, in other words, to find out what is the nature and extent of work necessary to their synthesis; these he considers fundamental data in chemistry as well as physiology. In these papers he gives a *resumé* of the experimental results arrived at with the principal classes of organic compounds. His reasonings, in general, rest upon the principle of active forces; they consist in comparing two equivalent systems—susceptible, on the one part, of being transformed one into the other; and in the other part of furnishing, by complete combustion, the same amounts of water and carbonic acid. In the calculations he relies partly on Dulong's determinations of the heats of combustion, but more especially on the data furnished by MM. Favre and Silberman.

**I. Carbides of Hydrogen.**—The carbides  $\text{C}_2\text{nH}_{2\text{n}}$  preserve very nearly the calorific energy of their elements. Thus olefiant gas  $\text{C}_4\text{H}_4$  produces 324 units of heat, its elements furnishing 326;  $\dagger$  the combustion of amylene  $\text{C}_{10}\text{H}_{10}$  produces 804, that of its elements 815. These numbers are as close as possible; and their slight differences may be attributed to changes of state and physical arrangements. It has been shown that we can argue with certainty upon differences which do not exceed two or three hundredths of the principal quantities. The heat of the combustion of ethylene  $\text{C}_2\text{H}_2$ , however, is lower by  $\frac{1}{16}$ th than that of its elements, and in this case we must regard the difference as representing the heat disengaged in the formation of a carbide so condensed and so little volatile.

2. In general we may calculate very nearly the heat of combustion of a carbide  $\text{C}_2\text{nH}_{2\text{n}}$  of an alcohol, an ether, and an acid, by adding to that of a homologous body from which it differs by  $\text{nC}_2\text{H}_2$ , the number  $\text{n} \times 155$ . Since  $\text{C}_2\text{H}_2$  answers to 163, the difference 8 expresses the mean work expended in the transformation of a body into its homologue; that is,  $\frac{1}{20}$ th of the heat produced by the combustion of the elements which we add to or subtract from the homologous body.

3. The heat of combustion of the oils of turpentine and lemon  $\text{C}_{20}\text{H}_{16}$ , carbides endowed with rotatory power, differs but little from that of their elements; but that of terebene, a carbide deprived of rotatory power, and derived from a transformation of the preceding bodies, is lower by  $\frac{1}{35}$ th. Thus a body optically active changed into an inactive isomer gives rise to a disengagement of heat.

4. The transformation of a carbide into a polymeric body also gives rise to a disengagement of heat. This is remarked in the complete transformation of terebinthene into polymers under the influence of fluoride of boron. Thus the heat of combustion of amylene as stated above is 804, but that of tretamylene  $(\text{C}_{10}\text{H}_{10})_4$  is only 3060. This loss of heat is always correlative with an increase of density and boiling point.

While the equivalent and vapour density are doubled in polymers, the specific heat scarcely changes, a circumstance very important in the discussion of the atomic weights of simple and compound bodies. It proves that these cannot be determined absolutely (otherwise than to a near multiple) by the specific heats.

5. The type of carbides formed with disengagement

\* *Comptes Rendus*, t. lx., p. 485.

$\dagger$   $\text{C}_2 = 94$ .  $\text{H}_2 = 69$ .



of heat is *formene*, or marsh gas,  $C_2H_4$ . Its combustion gives 210 units of heat, and that of its elements 232; whence it follows that the production of formene in its actual state disengages 22 units of heat; this is nearly the same quantity of heat which answers to the formation of the same volume of  $NH_3, HCl$ , the third of that relative to  $H_2O_2$ .

6. The following comparison deserves some attention: Let us suppose that the heat of combustion of the formenic carbides,  $C_2nH_{2n+2}$  may be calculated by adding  $n \times 155$  to that of formene, according to the law observed in the various homologous series of carbides, alcohols, acids, etc.; we know further that between the ethylenic carbides  $C_2nH_{2n}$  and the formenic carbides  $C_2nH_{2n+2}$  there exist experimental relations of analysis and synthesis. Let us see the calorific effects which accompany these metamorphoses. The system  $C_4H_4 + H_2$  produces in burning  $334 + 69 = 403$  units of heat; the system  $C_4H_6$  will produce  $210 + 155 = 365$  units.

The union of an ethylenic carbide with hydrogen to form a hydride will give rise to the disengagement of heat, and the inverse transformation to an absorption. It is easy to show that these conclusions are conformable to the production of hydride of ethylene in the reaction of water on iodide of ethylene.

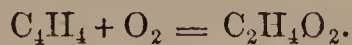
The carbides  $C_2nH_{2n}$  disengage heat not only in uniting with hydrogen,  $H_2$ , but also with oxygen,  $O_2$ , as I shall presently prove; with chlorine, with bromine,  $Br_2$ , as it is easy to verify; and with the hydracids, as I have observed in the case of amylene. This circumstance, and the conservation of the calorific energy of their elements prove that they are true radicals of organic combinations.

**II. Alcohols.**—By fixing the elements of water upon olefiant gas I have obtained ordinary alcohol; by oxidising marsh gas I have obtained methylic alcohol; let us examine what calorific phenomena answer to these general methods of synthesis.

1. The formation of ordinary alcohol by hydration seems to involve only a slight disengagement of heat, for the heat of combustion of alcohol 321 (mean of Dulong, Andrews, Favre, and Silbermann) is rather less than 334, that of the equivalent system  $C_4H_4 + H_2O_2$ .

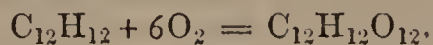
Analogous relations exist between amylene and ordinary amylic alcohol; the heat which is disengaged in changing the carbide into the alcohol will be equal to one-fiftieth of the heat of combustion of the carbide. These differences are low enough to be open to a doubt. They prove that the carbide derived from the decomposition of the alcohol into water and carbide, or the alcohol obtained by the inverse synthesis, preserve almost entirely the calorific energy of the initial system.

2. The method of oxidation produces more characteristic effects. Let there be two systems expressed by the equation—



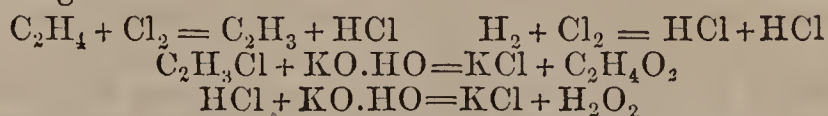
The combustion of the first gives 210 units of heat; that of the second 170; whence it results that the transformation of marsh gas into methylic alcohol disengages 40 units. This is about the quantity of heat that will result from the union of the hydrogen with the same volume of oxygen.

The relations between homologous bodies seems to allow a generalisation of these facts. Perhaps we may even apply them to the polyatomic alcohols. Such will be the analogous transformation of the carbide  $C_{12}H_{12}$  into glucose  $C_{12}H_{12}O_{12}$ , that is to say into a polyatomic alcohol—



$C_{12}H_{12}$  produces 959 units of heat;  $C_{12}H_{12}O_{12}$  726; the difference 233 divided by 6 = 39. The formation of sugar thus enters into the general law of alcohols.

Let us now trace the successive reactions by which we change formene into methylic alcohol, and compare them with similar mineral reactions performed upon hydrogen.



As the transformation of marsh gas into alcohol produces less heat than that of hydrogen into water, we may conclude from what has preceded that the mineral reactions which intervene in the case of marsh gas—that is to say, the final metamorphosis of chlorine and potash into hydrochloric acid and chloride of potassium, have not liberated the same amount of heat that would have been disengaged if these reactions had been exerted between chlorine, free hydrogen, and potash. A part of the heat of the formation of hydrochloric acid and chloride of potassium is absorbed in the synthesis of methylic alcohol.

In the next communication I shall examine the formation of aldehydes, ethers, acids, amides, &c.

*On the Action of Sea Water upon certain Metals and Alloys, by F. CRACE CALVERT, Ph.D., F.R.S., F.C.S., &c., and R. JOHNSON, F.C.S.*

WE were induced to examine the action exerted by sea water, in consequence of the rapid changes which have taken place of late years in naval architecture, and especially in the substitution of metals and alloys for wood.

To carry out the above views, we took 20 square centimetres of each metal, which we cleaned with great care and attention, in order that the action of the sea water might have its full effect; then two plates of each metal were placed in separate glass vessels, and immersed in equal volumes of sea water. After one month the plates were taken out, and any compounds that had adhered to the surface carefully removed; the plates were then dried and re-weighed, and the loss estimated. To render our results of more practical value, we have calculated the action of 100 litres of sea water upon one square metre of each metal, and the following are the amounts of metals dissolved:—

	Grammes.
Steel . . . . .	29.16
Iron . . . . .	27.37
Copper (best selected) . . . . .	12.96
„ (rough cake) . . . . .	13.85
Zinc . . . . .	5.66
Galvanised iron . . . . .	1.12
Block tin . . . . .	1.45
Stream tin . . . . .	1.45
Lead (virgin) . . . . .	trace
„ (common). . . . .	trace

These results appear to us to lead to the following conclusions:—

1. That the metal now most in vogue for shipbuilding—namely, iron, is that which is most readily attacked.

2. That this metal is most materially preserved from the action of sea water when coated with zinc, and therefore, in our opinion, it would amply repay shipbuilders to use galvanised iron as a substitute for that metal itself.

The above facts perfectly confirm those which we have already published in our paper “*On Galvanised Iron for Armour Plated Ships*,” in which it was shown, that



when iron was in contact with oak they mutually acted upon each other, producing a rapid destruction of the two materials, whilst little or no action took place between galvanised iron and the wood.

3. The extraordinary resistance which lead offers to the action of sea water naturally suggests its use as a preservative to iron vessels against the destructive action of that element; and although we are aware that pure lead is too soft to withstand the wear and tear which ship bottoms are subjected to, still we feel that an alloy of lead could be devised which would meet the requirements of shipbuilders.

Feeling that experiments made with a limited amount of sea water might not be a fair criterion of the action of the ocean upon metals, we repeated our experiments upon plates of 40 centimetres square, which were immersed for one month in the sea on the western coast (Fleetwood), taking the precaution that they should be constantly beneath the surface of the water, and suspended by flax rope attached to a wooden structure, to prevent any galvanic action taking place between the plates and the structure to which they were attached.

The following are the amounts of metals dissolved:—

	Grammes.
Steel. . . . .	105'31
Iron . . . . .	99'30
Copper (best selected) . . . . .	29'72
Zinc . . . . .	34'34
Galvanised iron . . . . .	14'42
Lead (virgin) . . . . .	25'69
„ (common). . . . .	25'85

The above figures suggest the following remarks:—

That the action has been much more intense in this instance than when the metals were placed in a limited amount of water at the laboratory. These results are due probably to several causes acting at the same time, viz., that the metal was exposed to the constantly renewing surface of an active agent; and that there was also a considerable friction exerted on the surface of the plate by the constant motion of the water, there being at Fleetwood a powerful tide and rough seas. What substantiates this opinion is, that the lead plates undoubtedly lost the greater part of the weight, not by the solvent action of the sea water, but from particles of lead detached from them in consequence of their coming in contact with sand and the wooden supports to which they were attached; but this cause of destruction having been observed with lead plates, it was afterwards carefully guarded against in the case of all the other metal plates.

We also deemed it desirable to examine the action of sea water on various brasses. We therefore immersed for one month plates of various alloys in that fluid, and proceeded to record our results:—

ACTION OF 200 LITRES OF SEA WATER UPON ONE SQUARE METRE SURFACE OF THE FOLLOWING BRASSES:—

Composition of the Brasses.	Quantity of Metals Dissolved.			
	Iron.	Copper.	Zinc.	Total.
Pure copper . . 50				
Pure zinc . . 50				
100	—	1'110	10'537	11'647
Commercial brass:				
Copper . . 66				
Zinc . . 32'5				
Iron and lead 1'5				
100	0'579	3'667	3'324	7'570

Composition of the Brasses.	Quantity of Metals Dissolved.			
	Iron.	Copper.	Zinc.	Total.
Muntz metal (sheet):				
Copper . . 70				
Zinc . . 29'2				
Iron and lead 0'8				
100'0	0'438	4'226	2'721	7'385
Muntz metal (bars):				
Copper . . 62				
Zinc . . 37				
Lead and iron 1				
100'0	0'501	2'697	3'493	6'691
Prepared brass:				
Copper . . 50				
Zinc . . 48				
Tin . . 2				
100	0'365	7'04	3'477	10'882

The above table shows how very differently sea water acts upon divers brasses and the influence exercised upon the copper and the zinc composing them by the existence in them of a very small proportion of another metal; thus, in pure brass the zinc is most rapidly dissolved (which, *en passant*, is the contrary to what takes place in galvanised iron), whilst it acts as a preservative to the copper.

Tin, on the other hand, appears to preserve the zinc, but to assist the action of sea water upon the copper.

The great difference between the action of sea water upon pure copper and upon Muntz metal seems to us to be due not only to the fact that copper is alloyed to zinc, but to the small proportion of lead and iron which that alloy contains, and there can be no doubt that shipbuilders derive great benefit by using it for the keels of their vessels.

We were so surprised at the inaction of sea water upon lead that we were induced to compare its action with that of several distinct varieties of water, viz., Manchester Corporation water, well water, distilled water in contact with air, the same deprived of air, and the following are the amounts of metals dissolved by 200 litres of these waters upon one square metre of surface during eight weeks:—

	Grammes.
Manchester Corporation water . . . . .	2'094
Well water . . . . .	1'477
Distilled water (with air) . . . . .	110'003
„ „ (without air) . . . . .	1'829
Sea water . . . . .	0'038

These figures require no comment, as they confirm our previous result that sea water has no action on lead.

#### Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.\*

(Continued from page 160.)

THE least coloured earths precipitated and assorted as before described were redissolved in nitric acid and subjected to a new series of partial precipitations, for the purpose of separating from them the greatest possible amount of erbia, but a small portion of erbia will always remain in solution. I then mixed the erbia thus obtained with the first lot, transformed the whole into neutral nitrate, diluted with seven or eight times its weight of water. Erbia predominated in this liquid, but small quantities of terbia and yttria were present; by saturating it, when hot, with powdered sulphate of potash, I

\* Archives des Sciences Physiques et Naturelles, Geneva.



determined in it the formation of a soluble double erbio-potassic salt, soluble in pure boiling water, but insoluble in presence of an excess of sulphate of potash. It was then easy to extract the base in a perfectly pure state.

For greater certainty, I again dissolved it, and once more submitted it to the same treatment. The impure terbia was, on the other hand, precipitated by an excess of caustic potash, and set aside for future researches.

I found erbia to possess the following characteristics, and it will be seen that they agree with those assigned to it by Mosander:—Precipitated when hot by an excess of alkali, it forms a white gelatinous hydrate, which washes perfectly well on the filter, and does not turn yellow by contact with the air, but absorbs from it a large quantity of carbonic acid. This hydrate dissolves with the greatest ease in diluted acids, and produces salts sometimes almost colourless, sometimes with a pale amethyst tint. Treated with a quantity of concentrated nitric acid insufficient to saturate it, it first forms a yellow subsalt, which loses its colour on the addition of water and acid. Its neutral nitrate solution slowly concentrated, then evaporated to dryness, forms a white, very slightly deliquescent mass; at a higher temperature, this mass fuses, forming a dark yellow limpid glass, which, by slow and steady cooling, sometimes solidifies without change in appearance; if its surface is then lightly scraped with a spatula, it cracks, and becomes white, with a radiated structure. By increasing the heat, the decomposition of nitrate of erbia is determined, first into a dark, reddish-yellow basic salt, then into a pure oxide. The subnitrate is formed by incompletely precipitating the hot neutral salt by pure ammonia. The erbic hydrate loses all its water at a red heat, assuming a dark yellow colour, often approaching orange. The lumps do not separate; they are heavy, broken with difficulty, and dissolve slowly in acids, leaving no residue, but disengaging a little oxygen. Obtained by the calcination of its oxalate, erbia is much more finely divided, and its pale yellow tint makes it easily confounded with pure ceroso-ceric oxide. Kept for a long time at a high temperature in a closed vessel, it turns white, and loses a little oxygen; in this property it resembles oxide of didymium. It is insoluble in potash, and when hot expels ammonia from its salts.

To establish very precisely the individuality of erbia, I made a comparative analysis between its sulphate and the corresponding salts of yttria and terbia, prepared under entirely identical conditions. For this purpose I dissolved, in a considerable excess of diluted sulphuric acid, the erbia above described, several grammes of pure yttria, and an earth composed essentially of terbia; the liquids, concentrated very slowly by means of gentle heat, deposited at about 80°, distinct and abundant crystals of earthy sulphates. Those of the first two earths were slightly rose-coloured, the colour of the terbia crystals being much more pronounced. M. Marignac kindly made a crystallographic examination of them, and found them to be perfectly isomorphic one with another, and with sulphate of didymium.

The general formula of these three sulphates is then  $(RO,SO_3)_3 + 8 aq.$ ; and the difference in the nature of their bases is given, as I shall show, by the different relative proportions of their component parts.

In making my analysis, I dried the salts at about 210° after having reduced them to a fine powder, moistened with water to extract the portions of acid mother liquor they retain, pressed in filtering paper, and

finally kept for some hours under a receiver, beside a vessel of sulphuric acid.

The residue thrown into cold water dissolved rapidly provided it was prevented from agglomerating by continual stirring. Erbia having a great tendency to form basic salts, it appeared to me better in estimating it to use neutral ammoniac oxalate instead of a caustic alkali. By precipitation, which I effected when cold, it gave a finely divided deposit, which passed readily through the filter; this may be prevented by the addition of a little ammoniac chloride, in which it is insoluble. On operating with hot erbia, the oxalate was crystalline, but as it does not form all at once, only one portion crystallises in several hours, attaching itself firmly to the rod and the sides of the vessel, and hence some uncertainty as to the result. Yttric oxalate traverses the filter much more readily than the other two.

In the conditions under which I operated, that is to say with a rather diluted liquid, an excess of reagent is no inconvenience. After washing and drying the precipitate was calcined at nearly white heat, cooled while protected from the air, and immediately weighed.

**Erbic Sulphate.**—0.827 gr. lost 0.177 = 21.40 per cent. of water and gave 0.353 = 42.68 per cent. of erbia.

1.0485 of salt lost 0.226 = 21.55 per cent. and gave 0.4475 = 42.68 per cent. of erbia.

For 0.803 I obtained: water 0.171 (21.29 per cent.) and earth 0.3415 (42.53 per cent.).

Another product obtained with an earth produced by a different treatment of gadolinite.

1.232 gave water 0.264 (21.43 per cent.) and earth 0.523 (42.45 per cent.).

1.1505 gave, earth 0.495 (42.60 per cent.).

	I.	II.	III.	IV.	V.	Mean.
Erbia .	42.68	42.68	42.53	42.45	42.60	42.59
Water.	21.40	21.55	21.29	21.43		21.42

The above results give the number 596 for the atomic weight of erbia, according to which the calculated composition of sulphate would be:—

	Calculated.	Found.
3ErO = 1788	42.69	42.59
3SO <sub>3</sub> = 1500	35.82	
8Aq. = 900	21.49	21.42
	4188	100.00

I endeavoured to effect the decomposition of sulphate of erbia by heat alone.

1.082 of sulphate calcined at white heat until its weight became fixed, gave 0.5765 of subsalt; thus only two-thirds of sulphuric acid were expelled.

**Sulphate of Terbia.**—1g. 294 gave 0.2795 (21.60 per cent.) of water, and 0.5405 (41.77 per cent.) of nearly white earth.

1.009 gave 0.220 (21.80 per cent.) of water and 0.4215 (41.77 per cent.) of earth.

1.271 gave 0.2755 (21.68 per cent.) of water and 0.5265 (41.42 per cent.) of earth.

	I.	II.	III.	Mean.
Terbia .	41.77	41.77	41.42	41.65
Water .	21.60	21.80	21.68	21.69

Mean atomic weight, 571.

The calculated composition of the sulphate is,—

	Calculated.	Found.
3TeO 1713	41.65	41.65
3SO <sub>3</sub> 1500	36.47	
8Aq. 900	21.88	21.69
	4113	



**Sulphate of Yttria.**—0.9545 gave 0.216 (22.68 per cent.) of water and 0.371 (38.87 per cent.) of yttria.

2g. 485 gave 0.565 (22.74 per cent.) of water, and 0.9585 (88.57 per cent.) of yttria.

2g. 153 lost 0.4935 (22.92 per cent.) of water, and gave 0.827 (38.41 per cent.) of earth.

Yttria	38.87	38.57	38.41	38.62
Water	22.68	22.74	22.92	22.78

Mean atomic weight, 500.†

Calculated composition of sulphate,—

		Calculated.	Found.
3YO	1500	38.46	38.62
5SO <sub>3</sub>	1500	38.46	
8Ag.	900	23.08	22.78
		3900	100.

According to the above the atomic weight of erbia would be very near 596. This number cannot be assigned to any of the analogous earths, without the supposition of grave errors in the results of my analyses, to which I have given the greatest attention; but as it is intermediate between those of cerous or didymic oxides and of yttria, chemists little accustomed to the study of these substances may suppose erbia to be simply a mixture of yttria and ceria or didymia.

(To be continued.)

#### *On the Electrolytic Precipitation of Copper and Nickel as a Method of Analysis, by WOLCOTT GIBBS, M.D.*

THE precipitation of copper by zinc, in a platinum vessel, with the precautions recommended by Fresenius, leaves nothing to be desired, so far as accuracy, ease, and rapidity of execution are concerned. The method labours, however, under a single disadvantage—the introduction of zinc renders it difficult, or at least inconvenient, to determine with accuracy other elements which may be present with the copper. It has occurred to me that this difficulty might be overcome, the principle of the method being still retained, by precipitating the copper by electrolysis with a separate rheomotor. The following numerical results, which are due to Mr. E. V. McCandless, will satisfactorily show the advantages of the method for the particular cases in which it is desirable to employ it. The copper was in each case in the form of sulphate; the deposition took place in a small platinum capsule, which was made to form the negative electrode of a Bunsen's battery of one or two cells, in rather feeble action. The positive electrode consisted of a stout platinum wire, plunged into the surface of the solution of copper at its centre. The following table gives the results obtained in the analysis of pure sulphate of copper:—

Number.	Salt taken.	Copper found.	Percentage.
1.	1.2375	0.3145	25.41
2.	0.4235	0.1075	25.38
3.	1.0640	0.2705	25.42
4.	1.3580	0.3440	25.33
5.	0.5665	0.1450	25.59
6.	0.4735	0.1205	25.48

In seven determinations of copper in the alloy of

copper and nickel employed by the Government for small coins the following results were obtained:—

Number.	Weight of alloy.	Copper.	Percentage.
1.	0.4160	0.3640	87.50
2.	0.6180	0.5410	87.54
3.	0.4600	0.4090	88.91
4.	0.5120	0.4481	87.51
5.	0.4220	0.3693	87.51
6.	0.2525	0.2225	88.11
7.	0.3705	0.3255	87.85

The percentage of copper required by the formula  $\text{CuO}, \text{SO}_3 + 5\text{HO}$  is 25.42, while the Government standard alloy of nickel and copper contains 87.50 per cent. of copper. The time required for precipitation varied from one to three hours, the separation of the last traces of copper being in each case determined by testing a drop of the liquid upon a porcelain plate with sulphuretted hydrogen water. The copper after precipitation was washed with distilled water, dried in a vacuo over sulphuric acid, and weighed with the platinum vessel. The only precaution necessary is to regulate the strength of the current so that the copper may be precipitated as a compact and bright metallic coating, and to dry as quickly as possible. When the copper is thrown down in a spongy condition, it not only oxidises rapidly, but it is impossible to wash out the last traces of foreign matter contained in the solution. This is well shown by No. 3 and No. 4 of the second series, in both of which cases the copper was precipitated too rapidly. The solution from which the copper has been deposited contains the other elements present in the original substance. It may be easily poured off without loss, and the washings added.

It appears at least probable that nickel may be determined by electrolysis in the same manner as copper, the solution employed being the ammoniacal sulphate with excess of free ammonia. Mr. McCandless obtained in two determinations in a commercial sample 91.36 and 91.60 per cent. of nickel. In both cases the nickel was thrown down completely as a bright, coherent, metallic coating upon the platinum. — *American Journal of Science and Arts*, vol. xxxix., No 115.

### TECHNICAL CHEMISTRY.

#### *Apparatus for the Decomposition of Pyrophosphate of Iron and Regeneration of Phosphorus.*

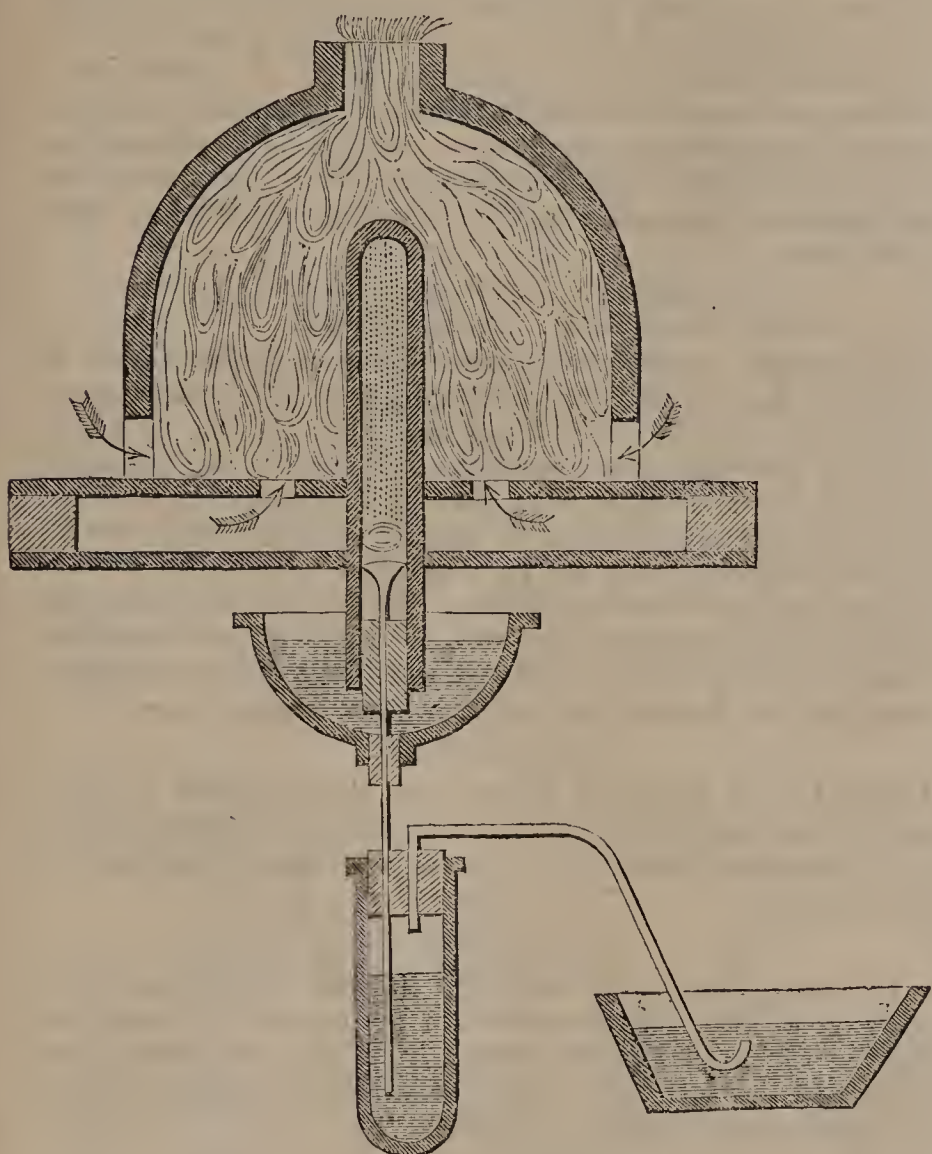
THIS apparatus, which is shown in the plate, has been devised by MM. Minary and Soudry, for obtaining phosphorus from the pyrophosphate of iron in forge cinders. It consists of an earthen furnace placed on a thick iron plate pierced with holes to allow of the introduction of air and the passing away of the cinder. Below this is another iron plate, which prevents the cinder falling on the lower portions of the apparatus, and which has a single hole in the centre to allow of the introduction of a porcelain tube. This porcelain tube is closed at the top, and half filled with vitrified phosphate of iron pulverised and mixed with coke dust. The bottom is closed by a cork traversed by a glass tube, wide-mouthed at the top, and opening at the bottom into a small closed receiver, two-thirds filled with distilled water. This is closed with cork at the top, which has a tube passing into the cistern through which the gas passes into the gas-receiver.

From 15 to 20 grammes of finely powdered vitrified phosphate of iron, mixed with 60 grammes of well calcined coke, is introduced into the porcelain tube, and

† It should be borne in mind that these numbers do not pretend to represent the exact atomic weights of the respective bodies; they are useful simply as a means of comparison, for showing in a more striking manner the existence of three earths in yttria. I believe, however, that the first and the last are very nearly exact, the second requires reconsideration.



then tightly tamped with asbestos, after which the tube is closed with a cork in the manner stated above. The



furnace is then slowly fired, so as to avoid a breakage of the tube; but subsequently the draft is increased and the temperature raised to a red heat. The phosphate of iron is decomposed, and the phosphorus distilled over is condensed in the water of the closed receiver in a state of white powder if the water is cold, but in a liquid state if the temperature of the water is raised to 50° Cent. (122° Fahr.)

If the coke has been previously well calcined, nothing escapes into the gas-receiver but oxide of carbon, the phosphorus being almost wholly collected in the closed receiver. If, however, the coke has not been thoroughly calcined, and still contains hydrocarbides, little or no phosphorus is collected, for it escapes into the gas-receiver as phosphuretted hydrogen, burning, as it escapes into the atmosphere, with great intensity and brilliancy. It is worth noting that when the phosphorus thus escapes, instead of being distilled and condensed, the operation is much more rapid.—*Mining and Smelting Magazine*.

## PHYSICAL SCIENCE.

*On the Disappearance of the Spectrum of  $\epsilon$  Piscium at its Occultation of January 4, 1865; with Conclusions as to the Non-existence of a Lunar Atmosphere, by WILLIAM HUGGINS, Esq.*

IN a paper recently presented to the Royal Society by myself and Dr. W. A. Miller, we gave the results of repeated prismatic examinations of different parts of the moon's illuminated surface. Since all these results were negative, they cannot be regarded as conclusive, but the amount of weight to which they may be entitled is opposed to the existence of a lunar atmosphere of considerable extent.

An observation which might furnish some information on this point still remained to be attempted—namely, that of the spectrum of a star a little before, and at the moment of, its occultation by the dark limb of the moon. It is well known that from ordinary telescopic observation of the disappearance of a star under those circumstances, no indications of a lunar atmosphere have been detected. From the absence of such indications, "we are," according to Sir John Herschel, "entitled to conclude the non-existence of any atmosphere at the moon's edge having one 1980th part of the density of the earth's atmosphere."

When, however, the observation is made upon the spectrum of a star, before, and at the moment of, its disappearance, several phenomena characteristic of the passage of the star's light through an atmosphere might possibly present themselves to the observer.

If a lunar atmosphere exist, which either by the substances of which it is composed, or by the vapours diffused through it, can exert a selective absorption upon the star's light, this absorption would be indicated to us by the appearance in the spectrum of new dark lines immediately before the star is occulted by the moon.

Again, if finely divided matter, aqueous or otherwise, of the nature of "fog" were present in the moon's atmosphere (a supposition to which telescopic observation is opposed), or even any considerable amount of invisible vapour, the red rays of the star's light would be enfeebled in a smaller degree than the rays of higher refrangibilities. In this case the blue end of the spectrum would appear to fade, leaving the red rays comparatively undiminished in brightness at the moment of the star's extinction.

If, however, there be about the moon an atmosphere free from "vapour," but of some density, then, because of the greater refraction which the more refrangible rays of the star's light would suffer in passing through it, the blue end of the spectrum would continue visible for a very small interval after the red rays had disappeared. Even if the moon's atmosphere were not of great extent, but sufficiently dense, the spectrum would probably not be extinguished at the same instant throughout its length, but a lagging of the violet and blue rays behind the red would be perceptible.

The telescope has an aperture of eight inches in diameter, and a focal length of ten feet. In the spectrum apparatus two prisms were employed, one having a refracting angle of 35°, the other of 45°. The spectrum was viewed through a small achromatic telescope of 6.75 inches focal length, furnished with an eyepiece magnifying nine diameters.

The telescope armed with this special apparatus was directed to  $\epsilon$  Piscium about five minutes before the almanac-time of the occultation, which was 5 h. 53 m. The clock-motion carrying the telescope was carefully adjusted, and by this means the image of the star was kept exactly upon the narrow slit of the spectrum apparatus.

During a period of three minutes, up to the disappearance of the star, I was able to observe the spectrum steadily and without interruption. Of the first point of interest, whether any dark lines additional to those belonging to the star appeared, I hesitate to speak decidedly. The state of our atmosphere was constantly varying, in consequence of which the stellar lines were seen with more distinctness at some moments than at others. A few seconds before the extinction of the star, I saw distinctly some lines in the red, which I had not before noticed. These lines, however, might have be-



longed to the star, and have been brought out by a greater steadiness of our atmosphere at that moment.

The mode of disappearance of the spectrum of  $\epsilon$  Piscium I can describe with more certainty. The spectrum did not go out in the manner for which I was prepared. I expected the spectrum would disappear by a sudden failure of its light, but such was not the impression produced at the moment of extinction.

The appearance suggested an opaque screen, equal in length to the spectrum, passing before it with a rapid motion in the direction of its breadth. On this occasion the spectrum as seen in the instrument was very narrow.

The duration of the blotting out of the spectrum in this manner, though it was so small that it might perhaps be called instantaneous, yet occupied an interval of time which could be appreciated. This interval did not differ greatly from two tenths of a second.

I was not able to detect that the disappearance of the spectrum was preceded by any failure of the blue, or of the red rays, but the spectrum appeared to remain unaltered in the relative intensity of its different parts up to the moment of extinction.

The advance of darkness upon the spectrum, since it occurred precisely in the direction of its breadth, swallowed up the rays of different refrangibilities throughout the whole extent of the visible spectrum, at the same instant.

The difficulties which attend the successful application of spectrum analysis to the heavenly bodies are so great, that much importance ought not to be given to a single observation of which the results are negative. A series of spectrum observations of the occultations of stars, especially if the list included some stars of greater brightness than  $\epsilon$  Piscium, might possibly afford us information of interest and value.—*Monthly Notices of the Astronomical Society.*

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

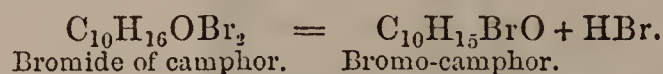
Thursday, April 6.

Professor W. A. MILLER, M.D., F.R.S., President,  
in the Chair.

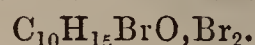
THE minutes of the anniversary meeting and of the two previous ordinary meetings were read and confirmed. Mr. George Jones was formally admitted a Fellow of the Society, and Mr. A. Vernon Harcourt, M.A., took the duties of Secretary. For the first time were proposed the names of Dr. Holtzmann, Marlborough House; Mr. Thomas C. Kirkham, Brompton; and Mr. Joseph Sugden, jun., Trinity House, Halifax. The names of W. E. Heathfield, F.R.G.S., Princes Square, Finsbury, and Mr. Arthur Clegg Bowdler, Oxford Road, Manchester, were read for the second time. The ballot was taken for the under-mentioned gentlemen, after their certificates had been read for the third time, and they were declared to be duly elected as Fellows of the Society—viz., Mr. Robert Barton, Bushy Park, Teddington; Mr. C. H. Berger, Lower Clapton; Mr. William Chrispin, Darlington, Durham; Mr. Alexander W. Gillman, Southfield, Wandsworth; Mr. Arthur S. Hobson, 3, Upper Heathfield Terrace, Turnham Green; Mr. William Judd, High Street, Christchurch, Hants; Michael Foster, jun., M.D., Huntingdon; and Mr. George B. Robertson, Cathcart Hill, Upper Holloway, and Stamp Office, Somerset House.

Mr. W. H. PERKIN read a "Note on a New Bromine Derivative of Camphor." By the action of heat upon Laurent's bromide of camphor,  $C_{10}H_{16}OBr_2$ , the author found, contrary to the statement of Gerhardt, that hydrobromic acid was eliminated with production of an oily

substance which ultimately solidified into transparent prismatic crystals, very similar in appearance to sulphate of soda, or it took the form, when impure, of tufts of needle-shaped crystals. The crude product was washed with weak alkali to remove every trace of hydrobromic acid and submitted to distillation, the liquid which passed over being further purified by a solution and crystallisation from alcohol. The change which bromide of camphor undergoes when heated may be expressed by the following equation—



The crystals of bromo-camphor have a slight odour of camphor, but their taste is very similar to oil of turpentine. They fuse at  $76^\circ$  or  $77^\circ$  C., and boil at  $274^\circ$  C.; the crystals are, however, appreciably volatile at ordinary temperatures. Heated with alcoholic ammonia in a sealed tube the substance furnished bromide of ammonium and a peculiar organic base, the properties of which the author is now engaged in investigating. By the action of bromine upon bromo-camphor the author obtained a crystalline mass, which he believes to be the bibromide of bromo-camphor, the formula of which is thus expressed—



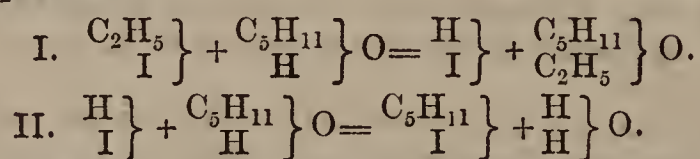
Again, by the action of heat upon this product another crystalline body is formed with evolution of hydrobromic acid, the result is supposed to be a bibromo-camphor of the formula,



Professor WANKLYN made a short verbal communication relative to the interpretation to be put on "*Friedel and Craft's Researches on the Ethers.*" These gentlemen have examined the action of iodide of ethyl on amylic alcohol, and find the products to consist of

1. Water;
2. Hydriodic acid;
3. Oxide of ethyl-amylic;
4. Iodide of amylic.

The following equations will explain the formation of these products:—



On extending their researches so as to include the action of the acetic ethers on the alcohols, they noticed a very remarkable fact—viz., that under these circumstances there was no formation of water, nor of acid, nor of oxides of alcohol-radicals. Thus, on exposing a mixture of acetate of amylic and common alcohol to a temperature of  $240^\circ$  C. for forty hours the only products were:—

1. Acetate of ethyl;
2. Amylic alcohol.

There was consequently no water, nor acetic acid, nor oxide of ethyl-amylic.

In like manner a mixture of benzoate of ethyl and amylic alcohol gave only—

1. Benzoate of amylic;
2. Ethylic alcohol.\*

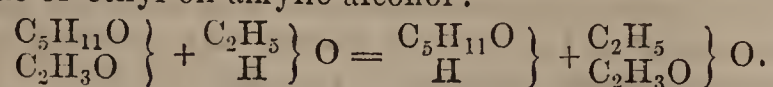
Professor Wanklyn then asked, "Why do not benzoate of ethyl and iodide of ethyl re-act in an analogous manner on an alcohol?" The theory which the author recently proposed is considered to furnish an explanation of this anomaly—viz., that, whilst the iodides and certain other ethers are really compounds of the alcohol-radicals, the acetic and benzoic ethers, &c., are salts of the so-called acid-forming radicals.

In the following equation the reaction is represented as an exchange of acetyl against hydrogen, and is evidently

\* Liebig's *Annalen*, February, 1865, p. 207, et seq.



analogous to the first equation representing the action of iodide of ethyl on amyl alcohol:—



Consequently, when iodide of ethyl acts on an alcohol ethyl changes against hydrogen; and when ethylate of acetyl acts on an alcohol acetyl changes against hydrogen. Thus Professor Wanklyn claims for his theory the advantage of establishing a parallel between the reactions, although the actual products in the two instances are different.

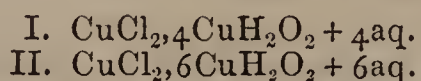
Mr. JOHN A. R. NEWLANDS then gave an account of "An Ammoniacal Deposit formed in the Process of Drying Blood." When visiting the premises of Mr. Richard Tons, of Bow Common, near London, where blood is dried for the purposes of manure, the author noticed a white crystalline deposit, sometimes stalactitic, adhering to an iron steam-pipe, and parts of the roof of a shed erected over the pans in which the process of dessication is carried on. This white crust proved on analysis to consist chiefly of sulphate of ammonium, and an average sample had the following composition:—

	Per cent.
Moisture . . . . .	0.44
Silicious matter . . . . .	0.32
Peroxide of iron . . . . .	1.21
Sulphate of calcium . . . . .	0.84
Sulphate of ammonium . . . . .	96.94
Chloride of ammonium . . . . .	0.07

99.82

The author accounted for its production by assuming the oxidation of sulphuretted hydrogen by air in the presence of steam and ammoniacal vapours, these gaseous substances being given off simultaneously during the evaporation and decomposition of the animal matters subjected to these processes of manufacture.

Professor A. H. CHURCH, M.A., having elicited the information that the "sulphate of ammonium" in the above analytical table was to be understood as being anhydrous, drew a comparison between the circumstances of its formation and that of the natural product, Boussingaultite, containing water of crystallisation, as described at a recent meeting of the Society. With respect to his previous statements relative to the stalactitic varieties of Atacamite, the speaker said that he had discovered upon Tallingite two new hydrated oxychlorides of copper, the formulæ of which were,—



The PRESIDENT then adjourned the meeting until Thursday, April 20.

## ACADEMY OF SCIENCES.

April 3, 1865.

M. MATTEUCCI contributed a memoir "On the Action of Sulphur in the Voltaic Pile." The learned author has studied the battery recently introduced by M. Blanc, who employs a plate of zinc and a plate of lead covered with a very thin deposit of copper, which are placed in a solution of common salt, with which is mixed a quantity of flowers of sulphur. This battery appears to be very useful for telegraphic purposes, and the only objection to its use is the evolution of some sulphuretted hydrogen, which would seem to be unavoidable. In the course of his experiments the author arrived at the following conclusions:—I. That finely divided sulphur in contact with the electro-negative metal of a pile formed of zinc, copper, and solution of common salt notably increased the electro-motive force, constancy, and permanency of the battery, and he hopes to obtain by the use of sulphur a voltaic combination pos-

sessing many advantages over the batteries at present employed. 2. Sulphur, although insoluble and an insulator, enters into combination with the sodium set free by the current. It remains for the author to explain the action of the small quantity of sulphide of copper which is formed, and which appears to be essential. For this end he has undertaken further experiments.

M. Naquet contributed a note "On Thymicylic Acid," which he has found was discovered five years ago by Kolbe and Lautemann, who described it under the name of *thymolic acid*. As the original discoverers have not continued the study, M. Naquet hopes to be allowed to continue it himself.

M. A. Saytzett presented a note "On the Action of Cyanate of Potash on Monochloroacetic Ether." On boiling these two bodies together for fifteen hours an abundant deposit of chloride of potassium is formed, and a liquid is obtained which a sufficient quantity of ether separates into two layers. The upper layer leaves on distillation a white crystalline body, proved to be allophanic ether,  $\text{C}_4\text{H}_8\text{N}_2\text{O}_3$ . The lower stratum was treated first with water to remove any allophanic ether, and the aqueous solution was then treated with dilute sulphuric acid. On cooling this solution deposited crystals of a new acid,  $\text{C}_6\text{H}_9\text{N}_2\text{O}_5$ , which the author proposes to call *oxyethylglycolylallophanic acid*, considering it as allophanic acid in which one atom of hydrogen is replaced by the monatomic group  $\text{C}_2\text{H}_2\text{O} \cdot \text{C}_2\text{H}_5\text{O}$ , *oxyethylglycolyl*. The author describes several oxyethylglycolylallophanates.

## NOTICES OF BOOKS.

*Chemical Technology; or, Chemistry in its Applications to the Arts and Manufactures.* By THOMAS RICHARDSON, M.A., P.D., &c., and HENRY WATTS, B.A., F.C.S. Second Edition. Vol. I, part 4. London: Bailliere. 1865.

THE part of this work we now notice—why it is called a "part" we are at a loss to imagine—is one of the most useful yet issued. It embraces an account of the manufacture of aluminium, sodium, soda, phosphorus, lucifer-matches, borax, mineral waters, gunpowder, gun-cotton, fireworks, stannates, tungstates, silicates, and some other important technical applications of chemistry. And when we say that the accounts of these manufactures are as good as can be given, and that to put them into operation it is only necessary that the reader should be possessed of that practical skill without which all reading of the kind is vain, we have said sufficient to show the high value of the work:

In a series of short notices, we propose to run hastily through the principal contents, referring our readers to the work itself for more minute details.

The manufacture of sodium and aluminium are so intimately connected that the two are very properly described together here. Attempts have been made to separate aluminium from its compounds by means of ordinary reducing agents, but without success on the large scale, and with uncertain success on the small. We have, however, seen small pieces of the metal which have been reduced with the aid of ordinary fluxes. Corbelli, of Florence, has in late years patented a method of reducing sulphate of alumina by means of ferrocyanide of potassium; but the metal obtained is said to be largely contaminated with iron. We are told nothing respecting the properties of such an alloy, which may be a useful compound. Cumenge proposes to obtain aluminium from a sulphide prepared by passing the vapour of sulphur over carbon, to produce bisulphide of carbon, and the vapour of this latter over heated alumina. In this stage of the process the carbon of the bisulphide takes the oxygen of the alumina, and the sulphur combines with the aluminium. Several means of reducing this sulphide



are given, so as to produce either pure aluminium or alloys. Sir C. F. Knowles reduces aluminium from the chloride by means of alkaline cyanides. Gerhard proposed to reduce fluoride of aluminium directly by means of hydrogen; but the process, which looks simple and easy of execution, has, we are told, been abandoned. Practically, we believe all the aluminium made is obtained by the aid of sodium; and the cheap and easy production of the latter metal is, therefore, a matter of the greatest importance—not for the production of aluminium alone, we may add. The uses of sodium are capable of indefinite extension, and we may regard its cheap production as a matter of great interest.

Nothing can be simpler than the process for obtaining sodium. It consists merely in distilling a mixture of charcoal and dried carbonate of soda. The admixture of chalk is, according to M. Tissier, unnecessary. But, unfortunately, only small quantities of the mixture can be submitted to heat at one time; and hence the application of the process becomes troublesome. The distillation is best effected in mercury bottles, but a so-called continuous process has been adopted, in which the distillation is carried on in cylinders, from which the exhausted charge is more easily withdrawn than from a mercury bottle.

By the aid of sodium, the preparation of aluminium is also extremely simple. A double chloride of aluminium and sodium, in powder, is mixed with small fragments of sodium, and the mixture is thrown upon the hearth of a reverberatory furnace. A vivid reaction soon ensues, and the aluminium is quickly reduced. When cryolite is employed, the operation is generally performed in a crucible, in which a mixture of cryolite and common salt and sodium are arranged in alternate layers. The former process yields the purest aluminium; the latter introduces silicon, if clay crucibles are employed, and iron if crucibles of that metal are used.

Aluminium may be said to be yet on its trial; but, if cheap, it might, no doubt, be applied to many useful and ornamental purposes; and the subject of its preparation is well worth the attention of chemists.

*Report on the Air of Mines and Confined Places.* By ANGUS SMITH, Ph.D., F.R.S. Part of the Appendix to the Report of the Royal Mines Commission. 1864.  
(Concluding notice.)

DR. SMITH has said that the presence of 0.1 per cent. of carbonic acid in an atmosphere is perceptible and hurtful, but it would seem that this is only the case when the gas is accompanied by organic exhalations, for he found the air in a soda-water manufactory, which contained nearly two-tenths per cent. of the acid, produced no discomfort when respired. We must therefore regard the organic matters in the atmosphere as the most serious contaminations, and the estimation of these as of the first importance. Unfortunately the satisfactory estimation is not an easy matter. Permanganate of potash solution, which is used to determine the amount of oxidisable matters, gives results which are very liable to mislead an experimenter, and in fact can hardly be considered to prove the presence of organic matter. So many substances are found in the atmosphere that are capable of decolorising a solution of the permanganate, indeed, that very little reliance is to be placed in the test. There is, however, a distinctive mode of action. Mineral substances, sulphurous acid and sulphites, sulphuretted hydrogen and sulphides, decolorise the solution instantaneously; organic matters discharge the colour but slowly, and "the slow action of organic matter," says Dr. Smith, "is very convincing when one becomes familiar with it." Under these circumstances any quantitative estimation of organic matters may be disregarded. Their presence in the air of mines, however, may be considered as conclusively established, for besides the permanganate another test was used which may be considered as more

reliable. "Part of the material from the tubes was burnt, and the unmistakeable odour of nitrogenous substances was perceived; burnt feathers give it in its ideal purity. As a final proof that organic matter was operated upon, carbon, black and combustible, remained behind." The nose also distinguishes various matters when air brought from mines is blown into the nostrils in a pure atmosphere; and, as Dr. Smith observes, the sense of smell is as much to be relied upon as any other sense. The nose did, in fact, detect in a bag of air brought from a mine the odour of burnt tallow, of tobacco smoke, and also that peculiar apple-like smell which every one will recognise near dirty people in a state of perspiration, and in most crowded assemblies.

Before we leave this part of the subject, we may mention a very simple method proposed by Dr. Smith for arriving at a tolerably close estimation of the amount of carbonic acid in an atmosphere. He starts with a normal solution of caustic baryta or lime, a small quantity of which—say half-an-ounce—he places in a bottle of known capacity filled with the air to be examined; the bottle is then shaken, and the amount of precipitate observed. In an atmosphere highly charged with carbonic acid, a very small volume of air gives a distinct precipitate; greater dilutions, of course, require larger volumes of air to give turbidity. Thus, if in a bottle holding about an ounce in which, allowing for the half-an-ounce of baryta water, there will be twelve cubic centimetres of air, distinct turbidity is caused, Dr. Smith has calculated that such air will contain 2 per cent. of carbonic acid. A table is given here, showing the amounts which may be inferred from experiments with bottles of various sizes. We may at a future time return to this question when we speak of Dr. Smith's experiments in the leaden chamber. We now pass on to notice very briefly the effects of bad air on the miner.

Cornwall appears to be an exceptionally healthy county. Infant mortality is less there than in Norfolk, and women are long-lived. It is only when they arrive at a working age that the lives of the men seem to become precarious, and this in the case of the Cornish miner cannot be attributed to accidental or violent causes. The metal miner is much less exposed to the risk of a violent death than the coal miner. In Cornwall the deaths from violence are only 109 in 100,000; while in coal mines the number is as high as 498 in 100,000. And yet the Cornish miner is a short-lived man. In healthy districts, and with healthy occupations, men at 20 may ensure 100*l.* for an annual premium of 1*l.* 7*s.* 7*d.*; but it costs a Cornish miner 1*l.* 17*s.* a-year to insure the same amount.

No doubt several causes co-operate in deteriorating a miner's health, but there can be no question that impure air has the most baneful influence. The deaths from lung disease are higher in Cornwall than in any other mining district.

Under these circumstances, we regard with much favour the proposal to subject mines to inspection, with a view chiefly to the introduction of improvements in ventilation. We have not the details of Lord Kinnaid's measure before us, but we feel assured that it contemplates nothing which will not prove to be equally advantageous to the proprietor and the miner. The former may, indeed, be considered as more interested in the miner's health than the miner himself; and we hope no ignorant and selfish opposition will defer the passing of a measure from which the most beneficial results may be anticipated.

*Zeitschrift für Analytische Chemie.* Edited by Dr. C. R. FRESSENIUS. No. 3, 1864.

For a wonder, we may say, this valuable journal contains nothing at once novel and useful for the readers of the CHEMICAL NEWS. Abstracts of most of the papers have already appeared in our pages, and the others are in course of preparation from their original sources.



*Chemisches Central Blatt.* Nos. 11, 12, 1865.

IN the former of these journals we have a paper by the late editor, Dr. Knop, "*On the Recovery of Uranic Oxide from Test Residues and the Preparation of Pure Uranic Oxide.*" The easy recovery of uranic oxide is a matter of some importance to chemists who use the nitrate or acetate of uranium for the determination of phosphoric acid. Salts of uranic oxide give a brown precipitate with ferrocyanide of potassium, which is decomposed by caustic soda or potash, giving ferrocyanide of potassium or sodium, and yellow uranic oxide. To recover the oxide from the phosphate, the author mixes the latter with twice its weight of carbonate of soda, and heats the mixture until it acquires a uniform brown colour. When cold, the soluble matters are extracted with cold water; and the uranium residue is afterwards dissolved in hot hydrochloric acid. This solution is treated with ferrocyanide of potassium, to obtain the brown ferrocyanide of uranium, which is decomposed, as above stated, by a caustic alkali. An excess of the alkali must be avoided. The precipitate, after well washing, is dissolved in boiling acetic acid, to which a little ammonia has been added; and the solution is then allowed to stand for a day. It is then filtered from any phosphate of uranium that may have deposited, and the filtrate is completely precipitated by ammonia. The uranic oxide so precipitated and well washed may be dissolved in acetic acid, and used at once for the determination of phosphoric acid.

A paper by Hosau gives "*The Composition of Dry and Fossil Sepia.*" Many chemists have made a chemical examination of the colouring matter of the cuttle-fish. The author obtained two of the colour-bags, which were very dry and hard, and were said to be very old. The specific gravity of the mass was 1.275. It broke with a conchoidal fracture, and when examined by the microscope appeared as a black amorphous substance, which underwent no change in colour when treated with acetic acid, potash, alcohol. Strong acids attacked it, nitric acid dissolving the greater part with a red colour. Sulphuric acid carbonised it. The mineral ingredients are not fully given by the author, who only remarks that chloride of sodium constitutes the greater part of the alkaline materials. Prout found sulphuric acid and iron, as well as phosphoric acid, iodine, bromine, and sulphur, neither of which the author appears to have discovered. He gives the following as the centesimal proportions of the organic constituents:—C 44.2, H 3.3, N 9.9, O 42.6. The abstract of a paper by Ludwig gives a method of separating the bitter substance in senna leaves, which we shall give in another place.

In No. 12 we have a paper by C. Rammelsberg, "*On a New Phosphate of Soda, and the Occurrence of Vanadium Compounds in Soda Ley.*" On evaporating down soda ley for the preparation of caustic soda, small red and yellow crystals have been observed to form before the carbonate of soda crystallises out. These the author shows to be tribasic phosphate of soda,  $3\text{NaO} \cdot \text{PO}_5 + 2\text{O aq.}$ , coloured by vanadium. An article "*On German Portland Cement,*" by Dr. Feichtinger, gives the composition of some cements which equal English in hardening quality. The composition will be seen to approximate closely to that of the best English:—

Lime	.	.	.	57.18	55.78
Magnesia	.	.	.	1.32	1.62
Alumina	.	.	.	9.20	8.90
Peroxide of iron	.	.	.	5.12	6.05
Potash	.	.	.	0.58	0.75
Soda	.	.	.	0.70	1.06
Silica.	.	.	.	23.36	22.53
Carbonic acid	.	.	.	1.90	1.46
Sulphuric acid	.	.	.	0.64	1.85
				100.00	100.00

The same author, in a paper "*On Winkler's Theory of the Hardening of Portland Cement,*" states his opinion that the hardening results from the formation of chemical compound of lime and silica, or lime and a silicate. In all hydraulic limes, he states, free lime is contained. He has already shown that, when Portland cement is made up with a strong solution of carbonate of ammonia, no hardening takes place, even when the excess of ammonia is washed out, in consequence of the lime becoming converted into carbonate; but if some hydrate of lime is added, the cement hardens, as well as fresh cement.

Most of the other papers are on organic chemistry, and have been already noticed.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

3. M. R. Leveson, Bishopsgate Street Within, "An improved method of treating apatite and other mineral phosphates." A communication from J. Oliver, Estremadura, Spain.—Petition recorded Jan. 2, 1865.

562. W. B. Dalston, Pittsburgh, Penn., U.S.A., "An improved atmospheric pressure lamp for the burning of benzole, paraffine, naphtha, or other volatile oils, which lamp may be used for all the purposes for which lamps are usually required, either for lighting, cooking, heating, or other purposes." Partly a communication from J. J. Riddle, Cincinnati, Ohio, U.S.A.—Feb. 28, 1865.

596. W. R. Bowditch, Wakefield, Yorkshire, "An improvement in carburetting gas, also in the preparation of hydrocarbons for carburetting gas, and improved methods of treating alkali which has been used to purify coal oils, shale oils, petroleum, and other mineral oils."—March 3, 1865.

629. T. Nicholson, Gateshead, "An improved process of, and apparatus for making caustic liquor or caustic lees."—March 6, 1865.

729. A. P. Price, Lincoln's Inn Fields, "Improvements in obtaining sulphurous acid."—March 15, 1865.

734. S. B. Boulton, Charlotte Row, London, "Improvements in the means and apparatus employed for treating timber with antiseptic or preservative fluids, also applicable to other purposes."—March 16, 1865.

### NOTICES TO PROCEED.

2913. W. Ibotson, Wraysbury, Buckinghamshire, "Improvements in the preparation of pulp for the manufacture of paper."—Petition recorded November 22, 1864.

2923. F. Millus, Poole, Dorsetshire, "An improved method of cooling liquids, particularly applicable to the cooling of wort."—November 23, 1864.

2984. H. Caunter, Stornoway, N.B., "Improvements in preserving ships' bottoms and other surfaces under water, and in preventing the formation of barnacles and other accumulations thereon; which improvements are also applicable as a preservative from the effects of moisture or damp, and as a cure or preventive of the scab in sheep, and a protection to them from the effects of damp and exposure."—November 30, 1864.

3018. C. W. Siemens, Great George Street, Westminster, "Improvements in apparatus for the production, purification, and combustion of gases for heating purposes."—December 3, 1864.

3116. J. Ellis, North Ormesby, Yorkshire, "Improvements in furnaces used in the manufacture and the heating and melting of iron, which improvements are also applicable to other furnaces."—December 16, 1864.

564. J. Fordred, Blackheath, Kent, "Improvements in treating certain hydrocarbon oils, and in vessels for containing the same."—February 28, 1865.



## CORRESPONDENCE.

*Continental Science.*

PARIS, April 11.

To make bitter ales with bitter aloes is not a bad idea. It is, at all events, a safer thing to use than strychnia or nux vomica, and it may be an agreeable way of keeping people's bowels regular. It ought, however, to be distinctly understood that such a substance is employed, as, indeed, it is said to be here; and it is well to know that it is not difficult to discover aloes in an alcoholic extract of the residue obtained by evaporating the beer. The idea may be worth the attention of some English brewer. An aperient ale would, I have little doubt, go down if well advertised in the *Lancet*.

The evacuations of Mount Etna during the late eruptions have been examined with much care by an intelligent and, I may say, an adventurous chemist, M. Fouqué, who has remarked a total absence of sulphur and its compounds in them. This, which seems at first sight extraordinary, has often been observed before, as related by Humboldt in the last volume of his *Cosmos*. On no part of the lava he has been able to visit has M. Fouqué noticed the smell of sulphuretted hydrogen or sulphurous acid, nor could he get lead paper blackened. The volatilised matters which cover the blocks of lava dissolved in water gave no precipitate with chloride of barium. M. Deville has explained that sulphur emanations follow the active state of a volcano in which chlorine appears to be the predominating electro-negative element evolved. M. Fouqué has distinguished four different varieties of fumaroles—dry, acid, alkaline, and carbonic. The dry he finds on lava still incandescent; the acid, upon lava still above 400° C.; the alkaline, at a lower temperature, but yet above 100°; and the carbonic, at about the ordinary temperature. Hydrochlorate of ammonia he finds very general. It is present in the acid fumaroles, and also—but he states in very small quantity—in the dry, which he has said are situated on red-hot lava. For those of your readers who have not read Humboldt, I may quote the explanation given by Deville, that the hydrochloric acid results from the decomposition of chloride of sodium by incandescent silicates in the presence of water.

M. Dode, a provincial chemist, has introduced platinum mirrors, which are greatly admired, and which present this advantage, that the reflecting metal is deposited on the outer surface of the glass, and thus any defect in the latter is concealed. The process, which is patented here, is described as follows:—Chloride of platinum is first made by dissolving the metal in *aqua regia* and driving off the excess of acid. The neutral chloride is then dissolved in water, and a certain quantity of oil of lavender is added to the solution. The platinum immediately leaves the aqueous solution and passes to the oil, which holds it in suspension in a finely divided state. To the oil so charged the author adds litharge and borate of lead, and paints a thin coat of this mixture over the surface of the glass, which is then carried to a proper furnace. At a red heat the litharge and borate of lead are fused and cause the adhesion of the platinum to the softened glass. The process is very expeditious. A single baking, M. Dode says, will furnish 200 metres of glass ready for commerce. It would take fifteen days, he says, to coat the same extent with mercury by the ordinary plan. A reduction of from 40 to 100 per cent. in cost of looking-glass will result from the adoption of this process; for any glass, even the common bottle metal, will serve to be coated.

M. Pierre Dronier is a waiter at a café; but that has not prevented him from cultivating science, and he has devised a plan for laying a submarine cable of any weight without fear of breaking it. If I understand his idea, he intends to navigate several ships on the same vertical line, one on the surface of sea, another 2000 metres down, a

third 4000 metres deep, and so on, and to drop the cable down from one to another, so letting it gently to the bottom without ever having the strain of more than 2000 metres on one break. We shall soon have drawings of the vessels and apparatus, and I will say nothing more of the plan until I see them.

Disputes with cabmen, I take it, are much more common in London than here, where, indeed, more pains are taken to prevent them. One of the most effectual of these will be some new apparatus constructed by MM. Meuley and Virdier, which shows upon two dials placed in sight of the fare the actual distance traversed by the vehicle, the time occupied in performing the journey, and lastly the time spent in waiting if any calls are made on the way.

The last number of the *Journal of Practical Agriculture* gives a very favourable account of the present state of the crops in France. The season is considered backward; but a little fine weather, it is said, will soon make up for lost time.

## MISCELLANEOUS.

**The Actonian Prize.**—We have much pleasure in announcing that this prize of 200 guineas for the best essay on the "Phenomena of Radiation as illustrative of the Wisdom and Beneficence of the Almighty," has been adjudicated to Mr. G. Warrington, F.C.S.

**Letts's "Monthly Postal Almanack."**—Under this title the Messrs. Letts now issue monthly a publication which will be found very useful to all having an extensive foreign correspondence.

**Committee on Chemists and Druggists Bills.**—On the motion of Sir F. Kelly, the select committee on the Chemists and Druggists Bills was composed of the following members:—Sir Fitzroy Kelly, Sir J. Shelley, Lord Elcho, Mr. Baring, Dr. Brady, Mr. H. Russell, Mr. C. Wynn, Mr. Ayrton, Mr. Selater Booth, Mr. Cox, Mr. Schneider, Sir J. Fergusson, Mr. C. Forster, Mr. Roebuck, and Mr. Black. Five to be the quorum.

**Royal Institution.**—The following are the probable arrangements for the Friday Evening Meetings after Easter:—April 28, Professor Lyon Playfair, C.B., F.R.S., "On the Food of Man in Relation to his Useful Work." May 5, Professor Henry Fawcett, M.A., "On Wealth and those who Produce it." May 12, Frederick Field, Esq., F.R.S., "On Magenta and its Derivative Colours obtained from Coal-tar." May 19, William Huggins, Esq., F.R.A.S., "On the Physical and Chemical Constitution of the Fixed Stars and Nebulae." May 26, H. Bence Jones, M.D., F.R.S., "On the Determination by the Spectrum Analysis of the Rate of Passage of Crystalline Substances into and out of the Tissues of the Living Body." June 2, Professor Huxley, F.R.S., "Ethnological subject." June 9, Professor Frankland, F.R.S., "Latest Researches in Organic Chemistry." The Friday arrangements depend in great measure on the free kindness of eminent men, whose time is subject to the sudden claims of public or professional duty. They are, therefore, liable to change.

## ANSWERS TO CORRESPONDENTS.

Mr. A. H. Church's communication shall appear in our next.

*Subscriber.*—They are not at present articles of commerce, but might, we think, be produced at no great cost. Apply to some operative chemist.

*G. M. E.*—We know of no separate work on the subject, but you will find all necessary information in the last edition of Ure's Dictionary.

*Books Received.*—"Practical Chemistry," by Dr. Stevenson Macadam. "Notes on the Manufacture of Sugar," by C. A. Goessmann. "Nitrogen shown to be Carbonic Oxide in an Allotropic State," by Henry Kilgour.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.

## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION II.—New System of Atomic Weights.

(Continued from page 170.)

II. PHOSPHORUS, arsenic, mercury, and cadmium are exceptions to the preceding rule. The weight of two volumes of vapour of phosphorus or arsenic (the double density as compared with hydrogen) represents, not two atoms, but four atoms of phosphorus or arsenic. The weight of two volumes of mercury or cadmium vapour represents not two atoms, but one atom of mercury or cadmium.

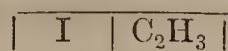
It may be asked if these exceptions are due to some anomaly, or to some error in the determination of the atomic weights? In our opinion the former is the true interpretation. The well-recognised analogy between nitrogen, phosphorus, and arsenic leaves no doubt as to the true atomic weight of these elements. Two volumes of ammoniacal gas combine with two volumes of hydriodic acid to form hydriodate of ammonia. Two volumes of phosphuretted hydrogen combine with two volumes of hydriodic acid to form hydriodate of phosphuretted hydrogen. Two volumes of ammoniacal gas are, therefore, equivalent to two volumes of phosphuretted hydrogen; and if two volumes of ammoniacal gas represent one molecule containing one atom of nitrogen, two volumes of phosphuretted hydrogen represent one molecule containing one atom of phosphorus. If ammonia is  $\text{NH}_3$ , phosphuretted hydrogen and arseniuretted hydrogen are  $\text{PH}_3$  and  $\text{AsH}_3$ , and not  $\text{P}_2\text{H}_3$  and  $\text{As}_2\text{H}_3$ . These latter formulæ correspond with the abnormal vapour density of phosphorus and arsenic. Everything now proves that these must be rejected and the former adopted. It follows, therefore, that in their combinations with hydrogen (and, we may add, with chlorine, bromine, iodine, and organic radicals), phosphorus and arsenic have the normal vapour density which would be in harmony with Ampère's law. That follows from the figures given in the table on page 158, where the molecular weights of the volatile combinations in question deduced from the true atomic weights (31 and 75) are identical with their double densities compared with hydrogen.

Mercury, cadmium, and doubtless zinc exhibit a contrary anomaly in their vapour-densities: their molecules are the same as their atoms; for the weight of two volumes of mercury vapour = 200, which ought to be the molecular weight, is really the atomic weight, deduced from the specific heat and chemical considerations; and what proves that this is true atomic weight is the fact that it agrees with the molecular weights of a large number of volatile mercurial compounds, as deduced from their vapour-densities. (See the table at page 159.)

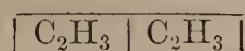
The same anomaly, if anomaly there be, is seen also in some organic radicals, comparable with mercury and cadmium. This deserves a word of explanation.

When iodine separates from the ethyl in iodide of ethyl, an ethylic group takes the place of the iodine in the iodide, and combines with the other ethylic group,

so as to constitute free ethyl, which occupies exactly the same volume as the iodide of ethyl in a state of vapour.

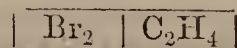


2 vols. of iodide of ethyl.



2 vols. of ethyl.

But when bromine separates from the ethylene in the bromide of ethylene, the radical ethylene set at liberty, instead of combining with another radical ethylene, dilates and occupies the space before taken up by the bromide of ethylene.\*



2 vols. of bromide of ethylene.



2 vols. of ethylene.

In the same way, when bromine separates itself from the mercury in mercuric bromide, the mercury set at liberty, instead of uniting with itself like ethyl, expands like ethylene, so as to occupy the whole space filled by the bromide of mercury.†

The compound radicals, ethylene, propylene, &c., to which we can add carbonic oxide,‡ are, then, in this respect comparable to the diatomic metals, mercury, cadmium, and zinc. Between the molecular formula of ethylene and that of ethyl there exists the same difference as that we find between the molecular formula of mercury and that of hydrogen or oxygen. The smallest quantity of these radicals which exists in a compound and which corresponds to one atom is the same as the smallest quantity which exists in a free state and represents a molecule. The foregoing is not an explanation; it is only a comparison; but in estimating the anomaly which the vapour-density of certain metals present, we must take into account such anomalies as we have quoted.§

It only remains to add a few words in order to demonstrate that the atomic weights which it is proper to adopt for certain simple bodies are confirmed by the vapour-densities of their volatile compounds. This will be seen on referring to the table given at page 158, which shows:—

1. That the vapour-densities of the volatile compounds of carbon, silicium, and boron, leave no doubt as to the atomic weights which must be attributed to these bodies.

If two volumes of hydrogen weigh 2, two volumes of chloride of silicium contain 28 of silicium; two volumes of chloride of carbon contain 12 of carbon; two volumes of chloride of boron contain 11 of boron.

So vanish the doubts which the law of Dulong and Petit might leave relative to the atomic weights of carbon, boron, and silicium.

2. The table shows that the vapour-densities of the volatile compounds of aluminium, iron, chromium, zirconium, tin, titanium, bismuth, zinc, lead, and mercury demonstrate that the atomic weights of these metals are double the equivalents now received, and are the same as the atomic weights of Berzelius, and thus deduced from the law of Dulong and Petit.

If two volumes of hydrogen weigh 2:—

Two volumes of stannic chloride contain 118 of tin;

\*  $\text{C}_2\text{H}_4\text{Cl}_2 = 99$  } See table at page 159.  
 $\text{C}_2\text{H}_4 = 28$  }

†  $\text{HgCl}_2 = 1 \text{ molecule} = 271$  } See table at page 159.  
 $\text{Hg} = 1 \text{ molecule} = 200$  }

‡  $\boxed{\text{Cl}_2 \mid \text{CO}}$  }  $\boxed{\text{C} \mid \text{O}}$   
2 vols. of chloride of carbonyl. 2 vols. carbonic oxide.

§ Our present notions of the atomicity of carbon, which we shall develop presently, allow us to conceive the existence of an unsaturated molecule  $\text{C}_2\text{H}_4 = 2$  vols. in which one atom of carbon is diatomic and the other tetratomic. When the vapour of mercury expands in giving up the bromine of the bromide (in which mercury plays the part of a diatomic element) it would seem that the metal becomes monatomic, and that its vapour is then formed of two atoms  $[\text{HgHg}] = 200$ .



Two volumes of chloride of titanium contain 50 of titanium;

Two volumes of chloride of zirconium contain 89.6 of zirconium;

Two volumes of zinc ethyl contain 65.2 of zinc;

Two volumes of mercuric chloride contain 200 of mercury;

Two volumes of ferric chloride contain  $2 \times 56$  of iron = 2 atoms;

Two volumes of chloride of aluminium contain  $2 \times 27$  of aluminium = 2 atoms.

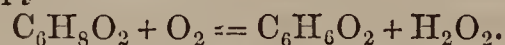
In fact, with the exceptions of ferric chloride and chloride of aluminium, to which we shall return, we have no reason to suppose that two volumes of the volatile compounds mentioned contain more than one atom of metal. The numbers given thus express the atomic weights, and it is easy to see that they are double the equivalents at present admitted.

(To be continued.)

*On the Calorific Phenomena which Accompany the Formation of Organic Compounds,\* by M. BERTHELOT.*

(Concluded from page 171.)

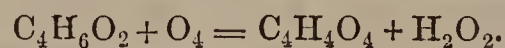
**III. Aldehydes.**—That the change of alcohols into aldehydes by oxidation gives rise to a disengagement of heat, is an everyday observation, but I know only one measure of the reaction. Acetone represents the aldehyde of propylic alcohol:



The combustion of the second system, however, produces 424 units of heat, and therefore that of the first should produce 476. The heat disengaged in the transformation of this alcohol into aldehyde is 52; this is less than a fourth of that disengaged in the formation of the same quantity of water from free hydrogen (69). The inverse reaction, the change of acetone into propylic alcohol,  $C_6H_6O_2 + H_2 = C_6H_8O_2$ , disengages 17 units.

**IV. Acids.**—Let us review the principal reactions by which organic acids are formed:—

1. *Oxidation of Alcohols.*—Acetic acid from ordinary alcohol,



Heat disengaged 111.

Valerianic acid  $C_{10}H_{10}O_4$  from amylic alcohol, 131.

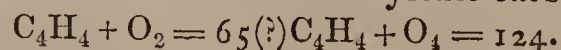
Formic acid  $C_2H_2O_4$  from methylic alcohol, 74. This last number is lower than the others in consequence of the anomaly already noticed relative to formic acid.

We see by the above that the heat disengaged by the union of four equivalents of oxygen with ordinary alcohol and with amylic alcohol is scarcely less than that disengaged by the same amount of oxygen with free hydrogen (138).

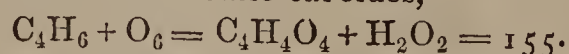
The numbers quoted represent equally the work necessary to change an acid into an alcohol by reduction.

The heat disengaged in the formation of acids from alcohol results from two consecutive effects; combustion of hydrogen (aldehyde stage), addition of oxygen (acid). These two stages would disengage nearly the same amount of heat, if it was proved that the formation of ethylic aldehyde answered to 52, the number found in the case of acetone.

The above numbers may also be in accordance with the results of the oxidation of ethylenic carbides,—

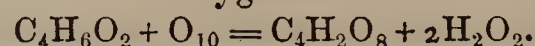


or with those of the formic carbides,



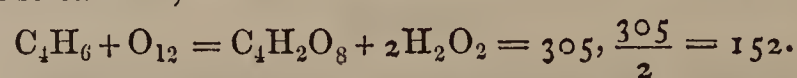
Thus  $O_6$  fixed upon  $C_4H_6$  disengages thrice the amount disengaged in fixing  $O_2$  upon  $C_4H_6O_2$  (52).

A more profound oxidation of alcohol begets acids with 8 equivalents of oxygen. Oxalic acid



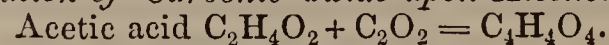
Heat disengaged =  $264 \times \frac{264}{5} = 53$  corresponding to  $O_2$ .

This oxidation may be in relation with that of a formenic carbide,—

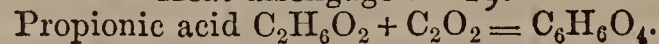


We thus see that the two consecutive and symmetrical reactions which produce the one acetic and the other oxalic acid by means of a formenic carbide would disengage almost the same quantity of heat.

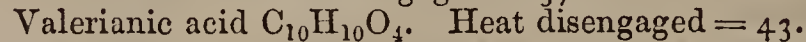
2. *Fixation of Carbonic Oxide upon Alcohols.*



Heat disengaged = 29.



Heat disengaged = 37.



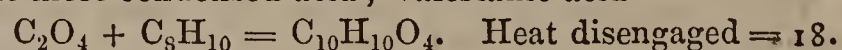
All these quantities are larger than those produced by the union of carbonic oxide with free oxygen (25).

If the reactions were referred to formic acid instead of carbonic oxide, it would be necessary to add 36 to the foregoing numbers.

3. *Fixation of Carbonic Acid upon Carbides of Hydrogen.*—Acetic acid  $C_2O_4 + C_2H_4 = C_4H_4O_4$ . Heat inappreciable.

In reality, there ought to be an absorption of heat in the atomic reaction, since the two gases are transformed into a liquid compound—a physical effect which gives rise to an absorption of heat; but I only reason upon the *actual state* of the systems.

This result, which agrees with my observations relative to formic acid, appears to change in sense in the case of the more condensed acid; valerianic acid



Here are the reciprocal effects to which the separation of carbonic acid gives rise: at the expense of formic acid it is accompanied by a disengagement of heat; at the expense of acetic acid the disengagement should be *nil*, and at the expense of valerianic acid there will be absorption of heat.

**V. Ethers.**—The combination of mineral acids with alcohols gives rise to well-marked calorific effects, as may be easily observed with hydrochloric, sulphuric, and nitric acids. But in the case of organic acids the phenomena are less distinct; experiment proves this directly, and the heats of combustion of ethers confirm it.

The differences in the heat disengaged in the formation of ethers correspond to analogous differences in the work necessary to decompose them. Thus the splitting up of nitric, sulphuric, and hydrochloric ethers is often more difficult to accomplish than that of the organic ethers, and gives rise sometimes to different products; simple ether or carbide instead of an alcohol, ethylamine in place of an amide, &c., &c.

It is no doubt for this reason that the equilibrium of etherification is sensibly within the same limits for the various organic alcohols and acids, while the limits are very different for the mineral acids. Hence, it may be, the part, hitherto unexplained, that mineral acids play in favouring the etherification of organic acids. Hence, perhaps, the production of organic ethers in the presence of free hydrochloric acid, as in the reaction of acid chlorides upon an alcohol. Under all these conditions, we see produced at first and by preference the ether, the

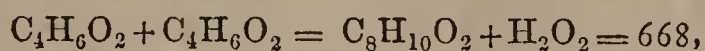
\* *Comptes Rendus*, t. lx., p. 485.



formation of which corresponds to the lowest calorific change—that is to say, the least change in the molecular state of the initial compounds.†

If we examine more precisely the formation of organic ethers, we find that the heats of combustion of *all the observed ethers*, with the exception of the formic ethers, are in excess of the sum of heats of the alcohol and the generating acid; the difference sometimes rises to  $\frac{1}{25}$ th—a singular circumstance, which it appears to me difficult to attribute to errors of experiment.‡ These facts would tend to establish the existence of a negative work beyond the transformation of the alcohol and acid system into the ether and water system *taken in its actual form*. Ought this negative work to be attributed to the atomic combination or to physical changes which supervene in the arrangement of molecules? The second explanation appears to me the more probable.

We come now to the ethers formed by the union of two alcohols: I will quote that of ordinary ether and ethylamylic ether.§ The heat of combustion of ordinary ether—



an amount very near that of the generating alcohol (660), according to Favre and Silbermann. But Dulong gives a number considerably higher (698), which better agrees with the analogies of compound ethers. In the same way ethylamylic ether produces 1161, and its generators 1109. The formation of mixed ethers, then, as well as organic ethers seems, to be accompanied by an absorption of heat. This circumstance is conformable with the necessity of a double decomposition producing by a simultaneous reaction the work necessary for the formation of these ethers.

It will be remarked that in the formation of mixed or compound ethers, the production of the water which is eliminated is not in general accompanied by a disengagement, as would happen if this formation answered to an oxidation. On the contrary, it will rather be correlative with an absorption of heat.

**VI. Amides.**—We have only data for one carbonated amide, cyanogen, as derived from oxalic acid—



The heat of combustion of cyanogen = 270, a number much higher than that of oxalate of ammonia, about 175.||

Thus, in the transformation of oxalate of ammonia into cyanogen, not only is the production of water unaccompanied by the disengagement of heat, but there is a considerable absorption of heat, analogous to that mentioned in the case of the mixed ethers. Reciprocally the fixation of water upon ether and cyanogen gives rise to a disengagement of heat.

It would, no doubt, be premature to extend this result to all the amides. I cannot, however, avoid noticing the interest these phenomena may present in the animal organisation, in which nitrogenised bodies of the amide order constitute the greater part of the tissues, in which the fatty bodies are so widely scattered, and in which the reactions of hydration are neither less frequent nor less important than the reactions of oxidation.

† By prolonged contact the inverse change may be observed in some cases.

‡ The exception of the formic ethers may be regarded here as confirming the rule.

§ I suppose that this is the body studied by Favre and Silbermann under the name of amylic ether.

|| The carbon of cyanogen if free would produce 188, an amount lower than 270; cyanogen, then, is a body resolvable into its elements with disengagement of heat, like protoxide of nitrogen and hypochlorous acid.

*On the Influence of Quantity of Matter over Chemical Affinity, as shown in the Formation of Certain Double Chlorides and Oxalates,* by GEORGE RAINEY, M.R.C.S.

THE simple fact that quantity of matter has the effect of influencing chemical affinity is so well known and so generally admitted that any special remark upon it would be superfluous. I shall, therefore, in this communication chiefly confine my observations to the compounds above named, by which this effect will be shown to be strikingly exemplified, offering such explanations and remarks thereon as the nature of the facts may seem to demand.

The results of nearly all the experiments mentioned in this paper were first arrived at by operating upon very minute quantities of material and by observing under the microscope the changes that take place; but afterwards the same products were obtained on the large scale by appropriate processes, and in quantities sufficiently large to admit of being analysed quantitatively and of having their formulæ accurately determined. I shall therefore commence by giving an account of the processes by which the various compounds I am about to treat of can be most easily prepared in minute quantities, and afterwards those by which they can be formed in any quantity that may be required.

All the apparatus necessary for the preparation of these compounds in quantities sufficient for microscopical examination are a few cells, made by cementing a ring of thin glass, such as is ordinarily used by microscopists, and some circular discs of thin glass to be employed as covers. The cell must be sufficiently shallow to allow of the examination of its contents with a lens of a half or quarter of an inch focus.

To prepare the compound of oxalate and chloride of strontium, introduce into a cell a few crystals of oxalate of strontia, and add to them as much saturated solution of chloride of strontium as will completely fill the cell; then cement upon the cell a thin glass cover in such a way that the cell shall be completely air-tight. A cell thus charged must be kept in a horizontal position, and examined from time to time. In a few hours the angles and edges of the oxalate of strontia crystals will be observed to have lost their sharpness of outline, being in a state of disintegration, and very minute crystals, altogether of a different form from those of the oxalate, to have made their appearance; and on successive examinations all the octahedral crystals will be seen to have disappeared and to have become replaced by exceedingly well formed rhomboidal crystals of different sizes, composed of the two salts introduced into the cell. In this experiment the solution of the chloride of strontium must be fully saturated; and if it even contain a few undissolved crystals, the processes of disintegration of the oxalate and formation of the compound will be prolonged, and more time allowed for their microscopical examination.

If, in the place of oxalate of strontia and chloride of strontium, crystals of oxalate of lime and a strong solution of chloride of calcium be introduced into a microscope cell, and the cell be closed up, the crystals of this oxalate (like those of the oxalate of strontia) will be seen by the microscope to become gradually disintegrated and replaced by an entirely different set of crystals, consisting of oxalate of lime and chloride of calcium. In this experiment either the oxalate made artificially or that obtained from any natural source may be employed; but the strength of the solution of the chloride of calcium must not be less than that of a



mixture consisting of equal parts by measure of a solution of this chloride saturated at a temperature of 60° Fahr. and water. The time required for the disintegration of all the oxalate of lime and its combination with the chloride of calcium to form crystals of the double compound of these salts depends upon the size of the crystals of oxalate of lime employed in the experiment. If they are very small, or if the oxalate is to all appearance amorphous, evidence of these changes will be visible in a few hours and the crystals completely formed in a few days; whilst if the oxalate crystals are large and well formed, some weeks will elapse before they have entirely disappeared and become replaced by the new crystals.

These changes are also influenced by the strength of the solution of the chloride of calcium; if it be fully saturated they take place more quickly, but the crystals will be small; if diluted, they will, on the contrary, be produced more slowly, and the crystals will be larger and better defined. Crystals of oxalate of magnesia put into a cell with a saturated solution of chloride of magnesium undergo similar changes, a double salt, consisting of oxalate of magnesia and chloride of magnesium, being formed. In this case the changes take place very slowly, several months being required for the formation of perfect crystals. These crystals have their sides and angles exceedingly sharp and well defined. Lastly, the oxalate of baryta and a saturated solution of the chloride of barium placed under the conditions above mentioned yield the same results, and crystals of oxalate of baryta and chloride of barium are formed.

The series of facts requiring notice in the process of formation of these double salts, as shown in the foregoing experiments, are, first, the disintegration, and at length complete dissolution, of a class of salts of very sparing solubility in strong solutions of chlorides of the same base, whilst weaker solutions do not in the least affect them; secondly, the combination under these circumstances of the oxalate and chloride of these bases to form double salts almost as little soluble as the simple oxalates; and lastly, the continued and simultaneous solution and deposition of these salts in a crystalline form in a quantity of fluid but little, if at all, exceeding the weight of the crystals deposited, until either all the oxalate crystals employed at the commencement are used up or the solution of the chloride has become too feeble to effect the further disintegration of those which are in excess. The most remarkable part of this process is the continued deposition of crystals after the saturation of the fluid in which they were formed, rendering a small portion of fluid sufficient for the production of a comparatively large quantity of crystals. This fact seems to indicate that in this case the newly-formed particles, immediately on their coming into existence in this fluid medium, are attracted more forcibly by the fluid than by one another, but that afterwards, when they have become augmented to a point above that which is said to be the point of saturation, their attraction for one another becomes greater than that for the fluid with which they are in contact; and being thus brought within the sphere of action of the forces necessary to produce crystals, these particles combine into the crystalline form.

Whether under conditions like the above a deposition of crystals is a necessary attendant on the formation of sparingly soluble substances in a fluid medium it is not possible to say, but in the course of these investigations I shall be able to adduce several other examples of a similar kind.

The experiments which have been related so far have

gone only to exemplify the influence of quantity of matter on chemical affinity as connected with simple chemical combination; but by a slight modification of these experiments the effect of the same principle on elective affinity can be demonstrated. For this purpose let a small quantity of oxalate of lime, either amorphous or crystalline, be introduced into a microscope cell filled with a completely saturated solution of chloride of strontium, and securely closed up. On examining such a preparation, the oxalate of lime is seen in a few days to be undergoing disintegration, and new crystals are seen to make their appearance, generally first at the sides of the cell. These crystals being formed slowly have a very sharp outline, and are remarkably transparent. In their form they resemble those obtained by putting oxalate of strontia into a saturated solution of the chloride of strontium; and notwithstanding that many of them have some of their angles cut off, and are thus made to present additional sides, their composition is precisely the same as if oxalate of strontia had in this instance been acted upon by a saturated solution of chloride of strontium. As in this experiment a chloride of calcium is formed at the expense of some of the chloride of strontium, the solution soon becomes too feeble to decompose the oxalate of lime, when of course the further formation of crystals will cease. Hence, to secure the best results, some crystals of chloride of strontium must be undissolved in the solution when put into the cell. By this means the processes of disintegration and the production of new crystals can be prolonged for many months, and an opportunity is thereby afforded of measuring them and of determining their rates of increase, or of making such other observations on the subject as the experiment may suggest.

The methods of forming the double compounds of the oxalates and chlorides of the alkaline earths in microscopical quantities having thus been described, it now remains to show how, on the same principle, these compounds can be formed on the large scale.

To prepare the double salt consisting of oxalate of strontia and chloride of strontium, it is necessary merely to mix oxalate of strontia (made by decomposing the oxalate of ammonia by chloride of strontium, and washing the precipitate by decantation, and not on a filter) with a solution of chloride of strontium kept at the point of complete saturation. In order that no lumps of oxalate may be mixed with the solution of the chloride, which would be unavoidable if any portion of the oxalate had been allowed to get dry, it is necessary, after finally washing the oxalate, to draw off as much of the water as possible with a syphon, and to add to the mixture of the oxalate of strontia and remaining water the saturated solution of chloride of strontium containing some undissolved chloride. If the solution of the chloride of strontium in which the oxalate is contained is fully saturated, the combination will begin in a few hours; but it will require two or three weeks before all the oxalate has combined with the chloride. This can be determined only by the microscope.

The double salt of oxalate of lime and chloride of calcium can be formed in the same manner. In the formation of this compound it is not necessary that the solution of the chloride of calcium should be fully saturated; and the weaker the solution of this chloride is, provided only it is of sufficient strength to combine with the oxalate, the larger will be the crystals of the double salt.

Since writing the above, I find that the same double compound of oxalate of lime and chloride of calcium



has been prepared by Fritsche by a different process.—  
*Proceedings of the Royal Society.*

*The Transformation of Nitrous Oxide (Protoxide of Nitrogen) into Nitric Acid and Ammonia (the Binary Compounds from which it is Formed),\* by M. J. PERSOZ.*

THE molecule of nitrous oxide is more complex than has been hitherto supposed, and it should contain, besides the latent heat which maintains it in a gaseous state, a certain amount of heat accumulated in the molecule, giving it, at least in part, the properties which characterise oxygenated water, certain oxides and peroxides, and finally several acids, which, in their molecular movements disengage a superabundant amount of heat, the theoretical cause of which cannot always be defined.

Its double molecule  $N_2O_2$  becomes, in fact, comparable to that of many of these compounds. As it then represents all the elements of ammonic nitrate, minus four equivalents of water, we must conclude that if it were possible under these circumstances to make water react on this molecule, we should regenerate nitric acid and ammonia in the same way that M. Pelouze, in his beautiful experiment on hydrocyanic acid, transformed this body into formiate of ammonia and *vice versa*.

The following experiment seems to us fully to bear out this opinion:—

Take a retort, about 125 cubic centimetres in size, pour into it nearly 50 grammes of fused nitrate of ammonia; to the neck of the retort adjust a small tubular receiver destined to condense the greater part of the water proceeding from the decomposition of the salt, and, by means of a tube, place this small condenser in communication with a combustion tube, bent slightly in the centre to keep the matter fused in that part of the tube. Fill about 15 or 20 centimetres of the length of the latter with a mixture of potassic hydrate and fragments of quick lime, to give freer access to the gas. Heat this tube to near dull red heat, and then pass the gas produced by the decomposition of the nitrate of ammonia, which is simply *nitrous oxide* gas charged with aqueous vapour. The current of gas being established, and the tube gradually heated, an abundant disengagement of ammonia takes place, recognisable by its odour and by its action on test papers.

If, after having maintained the disengagement of ammonia for a certain time, the experiment is brought to a close, the saline mass remaining in the combustion tube washed with water; if this liquid is saturated with chromic acid, evaporated to dryness, heated to red heat, and the residue mixed with twice its weight of potassic bichromate, abundant nitrous vapours will be disengaged, indicating the presence of nitric acid. This result leaves no doubt as to the possibility of transforming nitrous oxide (protoxide of nitrogen) into ammonia and nitric acid.

**New Green Pigment.**—Under the name of "Green Cinnabar," Vogel describes a new colour which is prepared in the following way:—Prussian blue is dissolved in oxalic acid; chromate of potash is added to this solution, which is then precipitated with acetate of lead. The precipitate, well washed, dried, and levigated, gives a beautiful green powder. By varying the proportions of the three solutions, various shades of green may be procured. Chloride of barium or nitrate of bismuth may be used in place of sugar of lead.—*Chem. Central Blatt*. [Another mode of preparing this colour will be found at page 182, vol. ix. CHEMICAL NEWS.]

\* *Comptes Rendus*, lx., 443.

## TECHNICAL CHEMISTRY.

*On Ancient Mortars, by WILLIAM WALLACE,*  
*Ph.D., F.R.S.E., F.C.S.*

HAVING, by the kindness of William Clarke, Esq., C.E., who has recently returned from the East, been supplied with specimens of mortars and plasters from well-known ancient buildings in Egypt, Greece, Italy, and the Island of Cyprus, I have submitted a number of them to analysis, with the object of determining several points of interest. The ages of the mortars vary from about 1600 to upwards of 3000 years, thus dating back to the most ancient historical periods. I propose in the present notice to give the results of the analysis of such of the specimens as I have examined.

**Mortar of the Great Pyramid.**—Two specimens of mortar from the Pyramid of Cheops were examined, one being from the interior and the other from the outside of the structure. That from the interior was from the great chamber or the passage leading to it. Both specimens present the same appearance—that of a mixture of plaster of a slight pinkish colour, with crystallized selenite or gypsum. They do not appear to contain any sand, the silicic acid being evidently in combination with alumina as clay. Part of the selenite was probably burnt, and the result mixed up with burnt lime, ground chalk, or marl, and coarsely-ground selenite. The latter would act the part of sand in our mortars—*i. e.*, prevent undue contraction in drying. The quantity of water is almost exactly what is required to form the ordinary hydrate of sulphate of lime with 2 equivalents of water. The mortar is easily reduced to fragments, but possesses a moderate degree of tenacity. Professor C. Piazzzi Smyth, who is at present making explorations in the pyramid, and to whom I have communicated the results of my analysis, has informed me that large quantities of gypsum and alabaster are found in its vicinity; and that some enormous slabs of alabaster or selenite have been discovered lining the walls of a large tomb recently opened. The material of which the pyramid itself is constructed being limestone, there is no difficulty in accounting for the presence of the lime.

	Interior.	Exterior.
Sulphate of lime, hydrated . . .	81.50†	82.39†
Carbonate of lime (CO <sub>2</sub> calculated) . . .	9.47	9.80
Carbonate of magnesia (do. do.) . . .	.59	.79
Oxide of iron . . . . .	.25	.21
Alumina . . . . .	2.41	3.00
Silicic acid . . . . .	5.30	4.30
	99.52	100.99

**Ancient Phœnician Mortars from Cyprus.**—Two specimens were obtained from Cyprus. The first is from the ruins of a temple near Larnaca, the highest stone of which, at present remaining, is five feet below the level of the ground, and the lowest about eighteen feet. Mr. Clarke supposes this to be the most ancient mortar in existence, and it certainly is one of the best I have ever seen. It is exceedingly hard and firm, and appears to have been made of a mixture of burnt lime, sharp sand, and gravel, some of the fragments being about half-an-inch diameter. On solution in hydro-

† Water by actual estimation, 16.66, 17.38.



chloric acid, it gave a small quantity of soluble silica, amounting to .52 per cent.

The other specimen from Cyprus is a cement used for joining water pipes. These pipes were found near Larnaca ten feet below the surface of the ground, and bear evidence of extreme antiquity; they are of red clay, about eleven inches diameter, and are connected by spigot and fawcet joints, the intervening spaces being filled with the cement and afterwards coated with a black substance which was found to be bitumen. This mortar or cement is very hard, and perfectly white in colour. It will be observed that in both of these Phœnician mortars the lime is almost completely carbonated.

	Temple.	Cement.
Lime . . . .	26.40	51.58
Magnesia . . . .	.97	.70
Sulphuric acid . . . .	.21	.82
Carbonic acid . . . .	20.23	40.60
Sesquioxide of iron . . . .	.99	—
Alumina . . . .	2.16	.40
Silicic acid and fine sand . . . .	16.20	.96
Coarse sand . . . .	3.37	—
Small stones . . . .	28.63	—
Organic matter . . . .	.56	.24
Water . . . .	.54	3.09
	100.26	98.39

**Ancient Greek Mortars.**—The first specimen is taken from a part of the Pnyx, the platform from which Demosthenes and Pericles delivered many of their orations. It has been long exposed to the action of the weather, is very hard, and of a greyish white colour. The other specimen is plaster from the interior of an ancient temple at Pentelicus, near Athens. It has not been exposed to the weather, the temple being in a cave; it is of a pale cream colour, and moderately hard. The analytical results are the following:—

	Pnyx.	Temple at Pentelicus.
Lime . . . .	45.70	49.65
Magnesia . . . .	1.00	1.09
Sulphuric acid . . . .	—	1.04
Carbonic acid . . . .	37.00	38.33
Sesquioxide of iron . . . .	.92	.82
Alumina . . . .	2.64	.98
Silicic acid and sand . . . .	12.06	3.90
Water . . . .	.36	3.07
	99.68	98.38

In the mortar from the pnyx the carbonic acid is exactly the amount required by the lime and magnesia, supposing both to be completely carbonated; in that from the temple the carbonating is nearly, but not quite complete.

**Ancient Roman Mortars.**—These differ from those already mentioned in being evidently prepared by mixing with burnt lime, not sand, but puzzolana, or what is commonly, although improperly, called volcanic ash. Of these four specimens were examined, but two only of the analyses were completed, owing to deficiency of material. The first in the following table was taken from Adrian's Villa at Tivoli, near Rome; it is a tolerably hard and firm mortar, of a rather dark grey colour.

The second is plaster from the interior surface of a wall at Herculaneum; it is hard, evidently exposed on one side to the action of hot volcanic mud, and of a red tint. The third specimen is from the roof of the Latin tombs near Rome, of a pale reddish-brown colour. The fourth is a cement or mortar from a mosaic forming the floor of the baths of Caracalla, Rome. All these mortars

were hard and firm, and contained an appreciable amount of silicic acid in combination:—

	Adrian's Villa.	Herculaneum.	Latin tombs.	Mosaic.
Lime . . . .	15.30	29.88	19.71	25.19
Magnesia . . . .	.30	.25	.71	.90
Potash . . . .	1.01	3.40	not estimated	
Soda . . . .	2.12	3.49	not estimated	
Carbonic acid . . . .	11.80	23.80	13.61	17.97
Peroxide of iron . . . .	4.92	2.32	1.23	3.67
Alumina . . . .	14.70	2.86	16.39	10.64
Silicic acid & sand . . . .	41.10	33.36	36.26	30.24
Organic matter . . . .	2.28	1.50	...	2.48
Water . . . .	5.20	1.00	8.20	5.50
	98.73	101.86		

**General Remarks.**—These analyses appear to show that the lime in mortars and plasters becomes in the course of time completely carbonated, and does not form a combination consisting of  $\text{CaO}, \text{HO} + \text{CaO}, \text{CO}_2$ , a conclusion that has been arrived at by some authorities. They also show that in all cases where the mortar is freely exposed to the weather, a certain proportion of alkaline or earthy silicate is formed, which in all probability confers additional hardness, and that those mortars are the hardest which have been long below ground. It is well known to builders that those walls are strongest that are built during a rainy season, and that when mortar dries quickly it becomes crumbly and possesses little binding power. When kept wet for some time, a small proportion of silicate of lime will be formed, which will not only make the mortar itself harder, but will unite it more firmly with the stone. It is curious that the mortar which is probably the most ancient (the specimen from a Phœnician temple) is by far the hardest and firmest, in fact, like a piece of rock. It is a concrete rather than a mortar, and its excellence seems to indicate that a large grained sand is best for building purposes, and that even small gravel may, in certain cases, be used with advantage.

Mechanics' Institution, Glasgow.

## PHYSICAL SCIENCE.

*On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood-stains,\** by H. C. SORBY, F.R.S., &c.

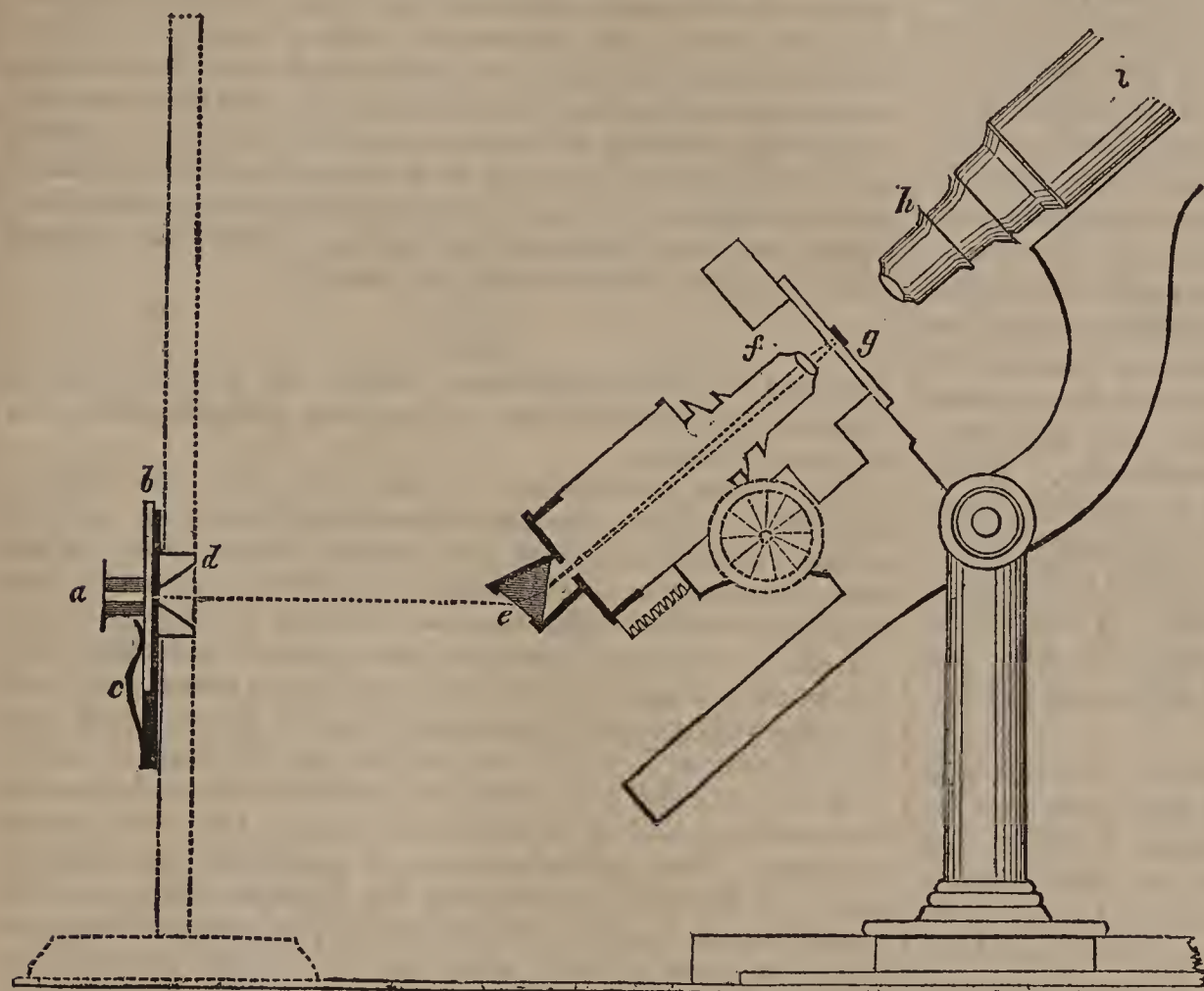
SINCE various substances may appear to have the same colour, and yet act very differently on the spectrum, or, on the contrary, may give the same characteristic spectrum, and yet differ materially in colour, it is in all cases desirable to study them by means of the prism. As is well known, this method has been employed with remarkable success in various branches of science; but, so far as I am aware, has not hitherto been applied to microscopical inquiries. In order to accomplish this, I have made a number of experiments, and at length contrived an arrangement which, so far, has answered every purpose required of it. I have also discussed the various particulars with my friends, the Messrs. Beck, who intend to adapt a similar arrangement to their microscopes, and we cannot perceive how any considerable alteration could be made with advantage, except such as would be required in the case of microscopes of different construction. I shall therefore describe what I have adapted to my own, one of their large binocular microscopes.

\* From the *Quarterly Journal of Science*.



The general construction will be more readily understood by reference to the accompanying Figure:—

SPECTRUM MICROSCOPE.



The only addition to the microscope itself is the prism (*e*) and its mounting, shown by the dark lines. This fits into the bottom of the moveable tube carrying the achromatic condenser (*f*). Detached from the microscope is a long narrow slit, shown in section at (*b c*); and the light passing through this at (*a*) is separated by the prism (*e*), and passes on to (*g*), where the image of the slit is seen as a coloured spectrum, on looking through the microscope in the usual manner. By this arrangement we can determine the character of the light transmitted by an object placed on the stage at (*g*), or by one held in front of the slit at (*a*); and, by a little adjustment, we can compare the two spectra side by side.

Having thus given a general account by way of introduction, I will now describe the apparatus in detail.

The slit is made of two brass plates about six inches long and one inch broad. The lower has two strips of brass fastened at each end, between which the other plate fits, so that it may be moved up and down, and fastened by means of screws, which clamp together the upper pair of the strips. The edges of the plates, thus brought together, are made quite straight and bevelled, so that by putting a small piece of thin writing paper at each end, pressing down the upper plate, and fixing it with the screws, an opening is left between the plates five inches long and about  $\frac{1}{400}$ th of an inch wide. The lower plate carries a small arm, fitting into a tube attached to a stand (shown by the dotted lines), such as is employed to hold a bull's-eye condenser, so that the slit is always horizontal, and that we may vary its height from the bottom of the stand, and the inclination of the face of the plates. Then, since it is often requisite to hold different sorts of objects in front of the slit, a piece of brass, to act as a stop, carrying a spring, is fixed on one side, as shown at (*c*), so that a square piece of glass can be held in the same position, or moved up and down

directly in front of the slit. In the figure the plates of brass are shown by the black portion (*b c*), the glass by the unshaded part on the left side below (*b*), whilst the shaded part at *a* represents a small narrow tube into

which any liquid may be put for examination. Large crystals or other objects mounted on plates of glass may also be held in the same manner. In some cases it is desirable to examine solutions held in test-tubes. For this purpose two pieces of wood are fixed on the other side of the brass plates, shown in section at (*d*), extending the whole length, and even projecting beyond them at each end. They are made in the V form shown in the figure, so that whether the tube be small or larger, its centre may be directly in front of the slit; and wood is better than brass when it is desirable to examine hot solutions. Towards each end is a spring, so that two tubes may be held, and the spectra of the liquids they contain compared. Of course all parts of these fittings must be a good, dead black. I have covered the brass with black silk, which cannot be scratched by the glasses, fastening it down with liquid india-rubber.

Since it is often desirable to have a narrow spectrum, a prism of crown-glass is better than one of flint-glass; and, when a broader spectrum is required, it can be readily obtained by using a condenser of longer, or an object-glass of shorter, focal length. The prism should be fixed in the position shown at *e*, so that the light may enter at *a e*, and pass off at *e g*, at about equal angles. With crown-glass the front face (*e*) should, therefore, be inclined at about  $10^\circ$  to the axis of the microscope. The prism might be fitted just within the tube of the condenser; but I have fixed it as shown, so that a large Nicol's prism may be inserted above it, to be used as described in the sequel. For some purposes day-light must be used, especially when it is desirable to have the blue end of the spectrum well seen; but very often lamp-light is better, for Fraunhofer's lines do not interfere with the observations, the quality of the light is more uniform, and, the lamp being placed at about the same height as the prism, the requisite inclination of the microscope is then just that which is most convenient for the observer. In using a lamp, a large bull's-eye condenser should be placed between it and the slit, so as to give a broad or narrower image, according to circumstances; and by throwing the image of the edge of the flame on the object, a larger amount of blue light may be obtained, if that be requisite. With day-light the condenser is not necessary, but the slit must usually be raised, the microscope inclined at a less angle, and a screen of blackened cardboard, with a suitable opening, placed in front of the slit, extending from the table to some distance above *b*, so as to shut out extraneous light. Since the uniform blackness of the field is often impaired by seeing the reflection of various parts of the microscope from the upper surface of the condenser, it is in all cases desirable to have a blackened tube fixed over the end of the object-glass, extending down nearly to the focus.

When all is properly arranged, the narrow beam of



light passing through the slit at *a*, gives a spectrum at the focus of the achromatic condenser (*f*), which is so adjusted that the focus may coincide with any object placed on the stage at *g*. Both are magnified by the object-glass (*h*), and seen on looking down the microscope; the spectrum extending horizontally across the field, having the red at the top and the blue and violet at the bottom. In my description it will therefore often be convenient to speak of the red as the upper, and the blue as the lower, end of the spectrum. The breadth depends on the focal length of the condenser and object-glass, and also on the distance of the slit from the prism, and the thickness and refracting power of any object placed on the stage at *g*. By using suitable lenses, we may readily obtain a spectrum  $\frac{1}{1000}$ th of an inch in width, so that the whole may be seen through a crystal of that minute size, or we may make the spectrum spread over the whole field of the microscope. However, it is usually much better not to have the condenser and object-glass of short focal length, since there is then more light, the spectrum is of better quality, and the different portions in better focus. A condenser of  $\frac{2}{3}$ rd of an inch focal length combined with an object-glass of  $1\frac{1}{2}$ , or a  $1\frac{1}{2}$  combined with a  $2\frac{1}{2}$  answer very well.

By using a micrometer in the eyepiece, the position of any dark or bright band in the spectrum can be readily measured with sufficient accuracy. I find it very convenient to use such powers, and fix the slit at such a distance that the whole spectrum measures twelve divisions of a micrometer, having lines  $\frac{1}{200}$ th of an inch apart. In that case the sodium line is as nearly as need be three from the top and nine from the bottom. The slit can be easily kept at the proper distance by means of a strip of wood resting above the prism and on the slit. To get a correct datum with lamp-light, I have a platinum wire with a loop holding common salt, so arranged that it can be turned into the flame, and the sodium line seen as a bright yellow band in the spectrum. After making one of the chief lines of the micrometer coincide with this, the wire can be turned out of the flame, and the position of any part of the spectrum measured. If day-light be employed, and a good object-glass used for the condenser, Fraunhofer's principal lines can be readily seen, and D may be made use of as a datum in a similar manner.

(To be continued.)

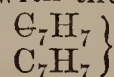
## PROCEEDINGS OF SOCIETIES.

### ACADEMY OF SCIENCES.

April 10, 1865.

MM. MICHAELSON AND LIPPMAN presented a memoir "On Bromide of Benzylidene and Two Hydrocarbons Derived from it." Benzylidene  $C_7H_6$  the authors consider the hydrocarbon common to all benzoic compounds, and of which bitter almond oil is the oxide. The chlorobenzol of M. Cahours— $C_7H_6Cl_2$ —they regard as chloride of benzylidene. They sought, therefore, to isolate the hydrocarbon, and with this view first set about preparing the bromide  $C_7H_6Br_2$ . For this purpose they took bitter almond oil (free from prussic acid) and treated it with perbromide of phosphorus, added slowly to avoid a complete decomposition. The compound obtained was washed with dilute potash to remove oxybromide of phosphorus, bromide of benzoyl, and benzoic acid, and subsequently with a strong solution of bisulphite of soda, to remove the unacted-on oil of bitter almonds. The residue, after drying over chloride of calcium, was distilled in a vacuum, the first and last portions of the distillate being rejected.

Analysis showed that the middle product was the desired compound— $C_7H_6Br_2$ . It is a refractive liquid, which becomes coloured red in the light, soluble in alcohol and ether, and which, under a pressure of 20 mm., distils between  $130^\circ$  and  $140^\circ$ . Sodium acts violently on this liquid at  $180^\circ$ , much hydrobromic acid being disengaged. The solid mass left, exhausted with ether, gives, on the evaporation of the latter, an almost black semi-liquid mass, which on distillation first yields toluol. The black residue remaining, distilled with the vapour of water, yields yellow oily drops, which solidify to a crystalline mass, which, after purification by successive crystallisations from ether, proves to be a hydrocarbon  $C_{14}H_{14}$ , which the authors think may be identical with the benzyl



obtained by Cannizzaro and Rossi. It is, they say, a diatomic hydrocarbon, for it combines directly with two atoms of bromine.

M. Wurtz contributed a note "On Abnormal Vapour Densities." The author has already published an account of his experiments with hydriodate of amylene; he has now extended his researches to the hydrobromate. This body he shows to offer a normal vapour density up to  $40^\circ$ ,  $50^\circ$ , and  $60^\circ$  degrees above its boiling point; but after this the density begins to diminish until it is reduced to half. The hydrobromate is thus shown to be decomposed into its constituents, which re-combine as the vapour cools. But not entirely, for a trace of hydrobromic acid remains uncombined, and is detected on opening the flasks under mercury. The hydrobromate of amylene, the author states, is specially convenient for determinations of this kind, since it resists a temperature of  $360^\circ$  without blackening. He gives a table, showing the vapour densities at various temperatures from  $153^\circ$ , at which the density equals 5.37 to  $360^\circ$  degrees, at which the density falls to 2.61. The decrease of density is not accomplished with perfect regularity. It falls slowly between  $153^\circ$  and  $185^\circ$ , but very rapidly from  $193^\circ$  to  $248^\circ$ . Above  $250^\circ$  the diminution is again slow. M. Wurtz concludes that at  $150^\circ$  the vapour is intact, for it has the normal density. At  $314^\circ$  the density equals 2.98, and the vapour is then composed as under:—

Undecomposed hydrobromate . . .	13.8
Amylene and hydrobromic acid gas . . .	86.2
	100.0

These facts the author considers to support the views of Deville on the dissociation of compounds at temperatures below that of total decomposition. He has extended his experiments to an examination of the vapour densities of hydrobromate of caprylene, which he finds to offer a normal density at  $277^\circ$ .

M. Mège Mouriès presented a note "On the Preparation of Soaps, and Fatty Acids for Candles." The author is not too explicit in his communications to the Academy, and all we can gather from his communication is an opinion that his process yields better products and a larger yield than the ordinary processes. He has said as much before in a former communication which we published in vol. ix., p. 291, of the CHEMICAL NEWS.

M. Lamy contributed a note "On the Phosphates of Thallium." We give here the author's results as stated, leaving controversial matters for another occasion. Thallium forms several compounds with phosphoric acid:—

A neutral phosphate,	$PO_5, 2HO, HO + HO$
An acid phosphate,	$PO_5, TlO, 2HO$
A basic phosphate,	$PO_5, 3TlO.$
A neutral pyrophosphate,	$PO_5, 2TlO$
An acid pyrophosphate,	$PO_5, TlO, HO$
A metaphosphate,	$PO_5, TlO.$

All these salts are white, nearly all soluble in water, and insoluble in alcohol. They give white precipitates with hydrochloric acid, and with nitric acid also when the solu-



tions are cold and not very dilute. The phosphates and pyrophosphates give besides white precipitates of tribasic phosphate with alkalis, while they are not precipitated by alkaline carbonates nor by alkalis in the presence of carbonates. The neutral phosphate is obtained by saturating phosphoric acid with carbonate of thallium; when heated this salt loses its water, and is converted into a transparent vitreous mass of neutral pyrophosphate. Phosphoric acid added to the former salt gives an acid phosphate, a very soluble salt crystallising in pearly plates. This salt when heated loses one or two equivalents of water, and gives either acid pyrophosphate or metaphosphate. The basic phosphate is made by adding an alkali to a solution of one of the two phosphates. This salt is but slightly soluble in water. From the general behaviour of the phosphates, M. Lamy draws conclusions in favour of the alliance of thallium with the alkaline metals, in support of which opinion he also quotes some other properties of thallium compounds.

M. Lorin communicated "*A Method of Reduction in Neutral Liquids*," in which there is nothing new. A mixture of zinc and iron heated with ammonia and an ammoniacal salt rapidly disengages hydrogen, the reaction becoming tumultuous as the temperature rises. Nitrate of ammonia, however, in dilute solution, submitted to the same treatment yields protoxide of nitrogen.

## NOTICES OF BOOKS.

*Chemical Technology; or, Chemistry in its Application to the Arts and Manufactures.* By THOMAS RICHARDSON, M.A., Ph.D., &c., and HENRY WATTS, B.A., F.C.S. Second Edition. Vol. 1. Part 4. London: Baillière. 1865.

(Continued from page 177.)

THE stannates of soda and potash, the methods of manufacturing which we find next described in the work before us, are of considerable commercial importance; but the processes by which they are produced offer nothing of particular interest. Those of Mr. Young are of the simplest character. He boils tin ore with caustic soda, and so obtains the stannate at once; or he fuses the tin ore with nitrate of soda, and thus procures stannate of soda and nitrous and nitric acids as by-products. The nitrate of soda may be replaced by chloride of sodium, and hydrochloric acid obtained for the by-product. On fusing metallic tin with solid hydrated soda, water is decomposed, and a stannite of soda is produced. On boiling this in water metallic tin is deposited, and stannate of soda is formed; or a little oxide of manganese added to the mixture of tin and soda before fusing converts the whole into stannate at once. Tin ore heated with alkaline sulphides also yields stannates; but secondary treatment is required to separate sulphur. This is done by boiling the soluble compound obtained in the fusion with hydrated oxide of manganese and iron. Stannate of soda or potash is also obtained by decomposing a stannate of baryta with an alkaline sulphate.

Dr. Richardson employs the alloy of tin and lead obtained in refining hard leads for the manufacture of stannates. He exposes the alloy to a current of hot air until it is completely oxidised. He then dissolves out the oxide of lead with acetic or nitric acid, and the residual binoxide of tin is converted into an alkaline stannate by one of the previously-mentioned processes.

In the short account of the processes for the valuation of tin ores in the dry, the reduction by means of cyanide of potassium is not mentioned. This process, which we published in our last volume (p. 315), is one of the most easily executed of dry analyses, and sufficiently accurate for all commercial processes.

Passing to the Tungstates, we find a full description of Mr. Oxland's process for the manufacture of neutral tungstate of soda, illustrated by useful drawings of furnaces. The process consists in heating wolfram ores with soda ash, in proper proportions, which gives tungstate of soda at once, mixed with the other matters in the ore. These are separated by lixivation, to effect which Mr. Oxland has an ingenious arrangement of vats. The other methods of producing tungstates require no notice; nor does Mr. Emerson's fancied discovery of a new metal *chlorolithenium*. The uses of the tungstates in dyeing and rendering fabrics non-inflammable are briefly mentioned and described.

The valuation of tungsten ores is a simple matter. If they do not contain tin they may be dissolved in *aqua regia*, the solution evaporated to dryness, and the soluble chlorides removed by solution in acidulated water. The tungstic acid which remains is washed with alcohol, and then dissolved in ammonia, which separates it from any silicic or niobic acid. If tin was present in the ore, the residuum after dissolving out the chlorides will be a mixture of tungstic acid and binoxide of tin, which may be treated by Mr. Dexter's process, who ignites it in a porcelain crucible with a perforated lid, through the opening in which he passes a stream of hydrogen. Metallic tin and binoxide of tungsten are thus produced; hydrochloric acid dissolves the former and leaves the oxide of tungsten.

The Chromates come next. Alkaline chromates are of course the starting points for the preparation of all the chromium compounds used in the arts, and the manufacture of these requires the first notice. The process for the manufacture of these is substantially the same as those for the alkaline stannates and tungstates. Chrome iron ore is heated with either an alkaline nitrate or hydrate with free access of air, whereby the sesquioxide of chromium is converted into chromic acid, which combines with alkali, and the soluble chromate is separated from the sesquioxide of iron by lixivation. The alkaline hydrate may be replaced by a carbonate, and if some lime be used an alkaline sulphate may be employed in place of a nitrate. Mr. Tilghmann has patented a process in which he employs felspar as the source of the alkali. He heats a mixture of four parts of felspar and four parts of lime with one part of chrome ore with free access of air. Mr. F. O. Ward has recently patented a similar process with the addition of fluorspar to facilitate the decomposition of the felspar. We need only notice one more process, that of Mr. Booth, who first reduces the iron by means of carbon, dissolves that iron out by sulphuric acid, and so produces green vitriol, and subsequently converts the residual sesquioxide of chromium into a chromate in the usual way. In this process it is said the whole of the chromic oxide is converted into chromic acid.

We see no allusion here to Kuhlmann's suggestion of the use of baryta as a base of chromic acid in place of potash. Chromate of baryta is said to effectively replace the alkaline chromate in many of its applications, and of course is most convenient in the preparation of chromic acid, as here described in the process of Mr. C. Watt.

The value of a chrome ore depending on the amount of chromium, the valuation is easily effected by a process similar to those for obtaining chromates; but it is best to employ a mixture of soda lime with a little nitrate of soda. Mr. Crace Calvert's process, here fully described, may be recommended for the ease with which it may be executed, and the satisfactory results obtained.

The preparation of alkaline silicates, and their application to the manufacture of artificial stone and the preservation of buildings, have been so frequently alluded to in our pages as to call for no notice from us beyond the remark that the account of them in this book, although it might have been fuller, is perhaps sufficiently full. But the authors might without much trouble have found some



useful applications of silicates besides those of Fuchs, Kuhlman, and Ransome, who usually monopolise the attention of book writers.

The best section on the subject of silicates is that on Stereochromy, which any reader interested in the subject will find full of useful information.

(To be continued.)

*Annalen der Chemie und Pharmacie.* March, 1865.

AMONG the papers in this number with which we have not met before is one by Limpricht, "*On Some Ingredients of Flesh-juice*," which will possess much interest for physiological chemists. The flesh of a young horse (the author does not say how young) was found to contain a considerable amount of dextrin, which the author was unable to detect in ox heart or fish flesh. From the same extract, prepared from about 200 pounds of the horse flesh, he also separated *taurin* and *inosite*. From herrings he obtained inosinic acid. Another original communication is by Dr. Märcker, "*On the Action of Nitrous Acid on Kreatinin*." A paper by Lossen, "*On Cocain*," gives a method of separating this, the active principle of coca leaves. The author exhausts the leaves with water acidulated with sulphuric acid. The extract is precipitated with sugar of lead solution, and the excess of lead removed by a saturated solution of sulphate of soda. The filtrate from the precipitate is made slightly alkaline with carbonate of soda, and then shaken up with several times its bulk of ether. Besides the cocain, ether takes up some colouring matter from which the alkaloid is separated by dialysis. With this view the residue from the ethereal solution is mixed with water, and then acidulated with hydrochloric acid and placed on the dialyser. The hydrochlorate of cocain passes rapidly into the diffusate, leaving the greater part of the colouring matter behind. To obtain the alkaloid quite pure it may be again precipitated by carbonate of soda, and recrystallised several times. The author, who took up this research after the death of Niemann, gives as the formula of Cocain  $C_{17}H_{21}N\Theta_4$ , which differs by one of carbon and one of hydrogen from the formula of Niemann. The alkaloid crystallises in colourless six-sided prisms; one part will dissolve in 704 parts of cold water; alcohol and ether dissolve it freely. A dilute solution of the hydrochlorate shows the following reactions:—Alkalies, caustic and carbonated, give a white precipitate; stannous chloride a white precipitate soluble in much nitric acid; mercuric chloride a bulky precipitate soluble in alcohol, sal ammoniac, and hydrochloric acid; chloride of gold a yellow precipitate in very dilute solutions; chloride of platinum a yellowish-white precipitate, which soon becomes crystalline; picric acid a yellow precipitate, which in a short time agglutinates; phospho-molybdic acid a yellowish-white flocculent precipitate. Tannic acid alone gives no precipitate, nor does iodide of potassium, bitartrate of potash, acetate of lead, ferric chloride, iodic acid. The author then describes some salts of cocain. When cocain is heated with strong hydrochloric acid in a sealed tube, it splits up into benzoic acid, methylic alcohol, and a new base, *Ecgonin*  $C_9H_{15}N\Theta_3$ , the chemical properties of which closely resemble those of cocain. The article concludes with some observations which establish a close resemblance between cocain and atropine.

The last paper we need notice is by Städeler, "*On Crystallised Carbonate of Potash*." In the preparation of uroxanic acid by the action of potash solution on uric acid. Besides the above-named acid and oxalate of potash, the author obtained from the mother liquors large transparent, colourless prisms of a salt, which, on analysis, proved to be  $2KOC_2O_4 + 3aq$ . Städeler examined crystals of carbonate of potash prepared in other ways, and concludes that a salt with four atoms of water does not exist.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

580. T. Horton, Priors Lee Hall, Shropshire, and D. S. Price, Great George Street, Westminster, "Improvements in the treatment of certain products obtained in the smelting of iron."—Petition recorded March 2, 1865.

618. E. Pettit, Birmingham, "A method of, or process for producing a new kind of photographic pictures."—November 4, 1864.

677. T. Reissig, Manchester, "Improvements in ascertaining the presence of 'fixing' agents in photographic productions, and in removing the said fixing agents therefrom."—A communication from W. Reissig, Vienna."—March 10, 1865.

691. J. Henderson, New York, "Improvements in the process and apparatus for refrigerating or freezing liquids."—March 11, 1865.

703. J. Webb, Lawrence Pountney Lane, London, "Improvements in the application and utilisation of certain materials suitable for the manufacture of paper."—A communication from J. J. Monteiro, Lisbon.—March 13, 1865.

727. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling oils and other liquids from coal and other substances."—A communication from W. G. W. Jaeger, Baltimore, U. S. A., March 15, 1865.

762. T. Kenyon, Miles Platting, Manchester, "Improvements in preparing, fixing, and mordanting cloth and yarns."—March 18, 1865.

788. R. A. Brooman, Fleet Street, "Improvements in the preparation of hydrated oxide of chromium." A communication from C. Kestner, Thann, France.—March 21, 1865.

796. W. M. Williams, Wrexham, Denbighshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid hydrocarbons, or for the manufacture of the said hydrocarbons and coke."

799. W. J. Coleman, Bury St. Edmunds, "An improved composition for clarifying and fining beer and other fermented liquors."

806. M. Morgans, Brendon Hills, Somersetshire, "Improvements in the manufacture and refining of iron and steel."—March 22, 1865.

817. R. A. Brooman, Fleet Street, "Improvements in treating fats and fatty matters for the manufacture of candles." A communication from E. Daugivillé and V. Balia, St. Berain-sur-D'heuve, France.—March 23, 1865.

871. J. C. C. Halkett, Cramond House, Mid Lothian, N.B., "An improvement in paints or compositions used for coating iron or wooden vessels and other structures exposed to the action of sea water."

877. R. Young, Dublin, and C. F. O. Glassford, F.C.S., Galway, "Improvements in the preparation or treatment of sea-weed, and in obtaining products therefrom."—March 28, 1865.

891. J. Player, Norton, Durham, "Improvements in furnaces or apparatus for heating the blast for furnaces used in smelting iron, and for other furnaces."

893. W. M. Fuller, "An improved process for reducing or preparing waste animal matters for the purpose of employing the same in the preparation of manures or fertilising compounds."—March 29, 1865.

797. H. Potter, Manchester, "Improvements in treating waste liquors obtained in bleaching certain vegetable substances."—March 22, 1865.

814. C. H. Crowe, Gloucester Road, Regent's Park, "Improvements in stoppers for bottles, jars, and other



vessels, the same being applicable to firearms and ordnance."—March 23, 1865.

834. J. B. Brown, St. Petersburg Place, Bayswater, "Improvements in casks or vessels for storing petroleum and hydrocarbons."

836. W. E. Newton, Chancery Lane, "Improvements in the manufacture of ink."—A communication from J. V. Lavers, Sydney, N.S.W.—March 24, 1865.

874. A. D. Gascon, Rue de la Fidélité, Paris, "A new febrifuge and digestive elixir."—A communication from A. Gascon, Ternes, Paris.

880. E. Savage, West Meriden, Conn., U.S.A., "Improvements in hardening and tempering steel."—March 28, 1865.

#### NOTICES TO PROCEED.

2981. R. F. Dale, Shoe Lane, London, "A new apparatus to be employed in drawing off and measuring paraffin and other oils, applicable also in drawing beer and other liquids, and measuring the same."—Petition recorded Nov. 30, 1864.

3048. C. A. Martius, Warrington, Lancashire, "Improvements in the application of photography to the ceramic art or to glass." A communication from J. B. Obernetter, Munich.—Dec. 6, 1864.

127. J. Young, Limefield, county of Mid Lothian, N.B., "Improvements in producing gases and vapour in a heated state."—Jan. 14, 1865.

222. J. H. Pepper, Boundary Road, St. John's Wood, and T. W. Tobin, North Street, Pentonville, "A new or improved apparatus for illusory exhibitions."—Jan. 26, 1865.

734. S. B. Boulton, Charlotte Row, Mansion House, London, "Improvements in the means and apparatus employed for treating timber with antiseptic or preservative fluids, also applicable to other purposes."—March 16, 1865.

### CORRESPONDENCE.

#### Continental Science.

PARIS, April 17.

SCIENTIFIC news is scarce here, and your Parisian contemporaries are reduced to the publication of extracts from the catalogues of apparatus and instrument makers. As these are well illustrated with diagrams and cuts, the extended publication of them will be useful, and I may refer you to the last number of *Les Mondes* for an account of some highly interesting acoustic instruments made by M. Koenig. The illustrated catalogue of this gentleman is, it is said, and without exaggeration, a real treasure to professors of physics, and deserves to be as well known in England as here. Unfortunately a verbal description of those instruments without the drawings would not have the smallest value, and I leave them with regret to notice matters of less scientific but more practical interest. One of these is a "dynamic evaporator," invented by M. Toselli, who is a manufacturer of ice-making machines. In these machines he employs a mixture of carbonate of soda and nitrate of ammonia to produce cold, and consequently gets a large quantity of solution of these salts on hand, which his object is to evaporate at the least cost. His apparatus to accomplish this is very simple. Parallel cords of vulcanised india-rubber are stretched over two rotating cylinders turning on horizontal axes. The lower cylinder revolves in a trough containing the saline solution, which is carried up by the cords, and the water is quickly dissipated, especially when the operation is carried on in the open air, and the solution brought down to a crystallising point.

There is another useful invention that deserves to be known in London, and this is the kneading trough, devised by M. Lenoir, the inventor of the gas engine. It is of

course adapted to the gas engine, which any journeyman baker could manage after half an hour's instruction. The mechanism imitates exactly the work performed by the baker's arms, and it is needless to say performs it without the disagreeable accompaniments of the human machine. The wooden kneaders do not perspire, nor is it necessary to hang a perspiring head over the trough. As a promoter of cleanliness and saver of labour, this machine deserves to be well known.

I believe I have mentioned before the discovery of a new silkworm in South America. We have to-day a further account of it from the brothers Durant Savoya, of Parana, who have found the same worm in provinces of Santa Fé and Entre Rios, in the Argentine Republic. The worm, which they propose to call *Bombyx Platensis*, feeds on a mimosa identical with that which yields gum arabic and senegal. In dry seasons, the writers say, large quantities of these gums may be collected. The silques are exceedingly rich in tannin, and may prove of value. The tree and the worm also, they believe, could be easily introduced and acclimatised in the South of France and Algeria. The importance of the silk industry to this country is so great that people look with intense interest on any new source of the material.

An incident at the last meeting of the Academy recalls to mind the archeological discovery of the immortal Pickwick. There was mention made some time ago of a great find of flint implements at Pressigny-le-Grand, in the vast antiquity of which MM. Quatrefages and Mortillet expressed their firm belief. M. Decaisne, however, went to the spot and questioned people living near, who told him that in past times tramps came every year and made gun-flints on the spot, and departed, leaving, of course, their chippings behind, veritable relics of an almost forgotten age—the age of flint locks.

If you have any entomologists among your readers, they may be glad to hear of a highly successful method of preserving the objects of their interest. M. Gerber employs an ethereal solution of carbolic acid with ten per cent. of the latter, which he finds to effectually protect the insects even in a place infested with ants. He recommends the solution especially therefore to entomologists making collections in hot countries.

I have sometimes felt surprise that no enterprising man in England had ever taken out a patent for the use of air for breathing purposes. What an extensive field that would open for royalties! I do not think that people here are quite so ready in attempting to monopolise common property as some in England, but one inventor(?) of the kind has just been put down at Toulon. This is M. Diess, who had the assurance to patent the use of sulphide of carbon for extracting grease, and the impudence to bring an action against a M. Deprat for infringing his patent. It is needless to say that the patent was considered "invalid for want of novelty!"

#### Formulae for New Copper Minerals.

To the Editor of the CHEMICAL NEWS.

SIR,—Will you permit me to answer in your journal some questions which have been lately asked me? Several correspondents seem desirous to know what formula I assign to the new cupric oxychlorides of Cornwall, and whether I regard them as distinct mineral species.

As to the first point, the following list will afford, I trust, sufficient information. The new minerals are marked \*, and are distinguished by their colours:—

1. Atacamite . . . . .  $\text{Cu}''\text{Cl}_2, 3\text{Cu}''\text{H}_2\text{O}_2, \text{aq.}$
2. \*Pale Mountain Green . . . . .  $\text{Cu}''\text{Cl}_2, 3\text{Cu}''\text{H}_2\text{O}_2, 3\text{aq.}$
3. \*Turquoise Blue . . . . .  $\text{Cu}''\text{Cl}_2, 4\text{Cu}''\text{H}_2\text{O}_2, 4\text{aq.}$
4. \*Deep Blue . . . . .  $\text{Cu}''\text{Cl}_2, 6\text{Cu}''\text{H}_2\text{O}_2, 6\text{aq.}$

The account of 1 and 3 will be published shortly in the Journal of the Chemical Society; the history of 2 and 4 will be made the subject of a second memoir.



As to the specific distinctness of these minerals, the data in my possession are as yet scarcely sufficient for a final judgment. I may say, however, that I am inclined to regard some of these oxychlorides as in a transitional condition; not, if I may be allowed the expression, as *mature* minerals. I am, &c. A. H. CHURCH.

R. A. College, Cirencester, April 3.

### MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday, April 25, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Thursday, April 27, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Friday, April 28, at 8 o'clock, Professor Lyon Playfair, C.B., F.R.S., "On the Diet of Man in relation to his Useful Work." Saturday, April 29, at 4 o'clock, Professor Bain, "On the Physical Accompaniments of Mind."

**Royal Polytechnic Institution.**—The Easter entertainment provided by Professor Pepper is of an unusually attractive character. Since the first apparition of the ghost at the Institution, nothing, we believe, will prove so permanently attractive as the new illusion introduced under the title of "Proteus; or we are here, but not here." The mysterious cabinet in which these startling illusions are produced will become more celebrated than the cabinet of the Davenport Brothers; for the tricks performed in it are, to common eyes, much more wonderful and mysterious. The production of Captain Burton's Pilgrimage to Mecca and Medina is highly creditable to the good taste of the manager, and the scenic and optical effects illustrative of incidents in the life of Mahomet deserve the highest praise. We ought also to say a word in favour of the exhibition of models of inventions calculated to promote safety in railway travelling, described by Mr. King. On looking at these models, we seem to see the possibility of avoiding every danger of railway travelling. There is a system of breaks invented by M. Boutet, which brings a heavily-laden train to an almost immediate stand-still, without producing a jar sufficient to disturb a spinning top; and a system of signals, by the same inventor, in which the trains act on the signals as they pass along, which are thus made independent of drowsy or careless signalmen. There is also at the Polytechnic a nice admixture of the amusing with the instructive, and an evening may now be spent there most agreeably and profitably.

**Sewage of Towns.**—Another instalment of the researches of the Commission appointed to inquire into the best mode of distributing the sewage of towns, and applying it to beneficial and profitable uses, has just been issued. The last report, as long ago as August, 1861, since which date Mr. Lawes and Professor Way, two of the Commissioners, have continued at Rugby the experiments which were undertaken in that year on the application of sewage to land. In reference to these experiments the Commissioners express their conviction that many of the difficulties which have hitherto attached to the question of the agricultural application of sewage have been solved, and leave no reasonable doubt of the practicability and advantage of so employing the sewage of towns. As the result of their labours, extending over eight years, the Commissioners submit the following as the conclusions they have arrived at:—"1. The right way to dispose of town sewage is to apply it continuously to land, and it is only by such application that the pollution of rivers can be avoided. 2. The financial results of a continuous application of sewage to land differ under different local circumstances. First, because in some places irrigation can be effected by gravity, while in other places more or less pumping must be employed. Secondly, because

heavy soils (which in given localities may alone be available for the purpose) are less fit than light soils for continuous irrigation by sewage. 3. Where local circumstances are favourable, and undue expenditure is avoided, towns may derive profit, more or less considerable, from applying their sewage in agriculture. Under opposite circumstances there may not be a balance of profit; but even in such cases a rate in aid, required to cover any loss, need not be of large amount. Finally," say the Commissioners, "on the basis of the above conclusions, we further beg leave to express to your Lordships that, in our judgment, the following two principles are established for legislative application:—First, that wherever rivers are polluted by a discharge of town sewage in them, the towns may reasonably be required to desist from causing that public nuisance. Second, that where town populations are injured or endangered in health by a retention of cesspool matter among them, the towns may reasonably be required to provide a system of sewers for its removal. And should the law as it stands be found insufficient to enable towns to take land for sewage application, it would, in our opinion, be expedient that the Legislature should give them powers for that purpose." Embodied in the Blue Book of the Commissioners is the report of the experiments conducted at Rugby by Mr. Lawes and Professor Way. These experiments were of a very varied and interesting character, and applied among other purposes to meadow land, to Italian rye-grass—experiments with fattening oxen and with milking cows; showing also the composition of the Rugby sewage, estimated average composition of the metropolitan sewage, composition of the drainage water (Rugby), and the effects of sewage on the mixed herbage of meadow land in developing the more freely growing at the expense of the less freely growing plants. Mr. Lawes and Professor Way, in their summary of the results of their inquiry, state that as there is a daily supply of sewage the year round, which, on sanitary and engineering grounds, it is essential to dispose of as soon as it is produced, and as passing it over land is the best mode of purifying and utilising it, it should be employed for purposes of irrigation, and be applied in winter, when of comparatively little value, as well as in summer, when it is of more. They state further that to obtain a maximum amount and gross value of produce from a given amount of sewage, it should be applied in small quantities per acre, and in dry weather; but the great dilution of town sewage, its large daily supply at all seasons, and its greater amount in wet weather, when the land can least bear, or least requires, more water, render it quite inappropriate for application on a comprehensive scale to arable land for corn and other ordinary rotation crops. The five appendices given with the report of the Commissioners embrace much tabular matter illustrative of the results of the experiments referred to; also notes on the sewage meadows of Croydon and Edinburgh; a paper by Mr. R. Rawlinson on the sewage of towns; and one on the contamination of air and water by sewage, by Dr. Stephenson Macadam.

### ANSWERS TO CORRESPONDENTS.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 12s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

R. B. P., U.S.A. Laboratory.—The Report is sent as desired.

J. O.—(1.) The paper "On the Estimation of the Mineral Phosphates" is in No. 239 vol. x. (2.) Either Gesner "On the Distillation of Coal" (Baillière), or Antisell "On the Manufacture of Photogen Oils," same publisher. For coal-tar colours read the CHEMICAL NEWS. Book Received.—"On Letters Patent for Inventions," by F. Edwards, jun.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.\**

(Concluded from page 174.)

THE following facts seem to me sufficient to set this question at rest:—

With the blowpipe yttria gives, in the two flames, with borax or salt of phosphorus, a limpid pearl, colourless both when cold and hot.

Terbia and erbia behave in the same way.

If they contain cerium, the pearl is opaline in the oxidising flame, dark yellow when hot, and almost colourless when cold.

Mixed with didymium, then heated in the reducing flame with microcosmic salt, they produce, when hot, an opaline glass, which becomes limpid, but turns to a violet amethyst hue on cooling.†

Yttrico-potassic sulphate is soluble in water saturated with sulphate of potash; sulphates of cerium and didymium are not so; consequently, in a mixture of the three earths, sulphate of potash separates the first from the two others.

A salt of yttria containing the minimum amount of cerium gives, with caustic potash, a white jelly, which turns yellow by exposure to the air, and dissolves, after calcination, in acids not too much diluted, giving a red or yellow liquid, hydrate of erbia, remains white in the air, even for several days, and its solutions are colourless.

Erbic sub-nitrate, prepared by the wet way, is dark yellow, even when air is excluded; didymic sub-nitrate is, and remains grey, when either hot, cold, kept from the air, or exposed to it.

Pure lanthanic oxide and yttria being white, give a mixture which is also white.

After moderate calcination didymiferous yttria has a light chocolate tint, while erbia is yellow.

By fractionally precipitating a nitrate of erbia, containing cerium, in the state of double potassic sulphate, the latter portions will give an earth quite as yellow as the first; but a trial with the blowpipe and the chemical analysis of the simple sulphates, will show very clearly that they are free from cerium, the latter being condensed in the first deposits.

The whole of the researches described in the present memoir seem to me to justify the following conclusions:

Mosander's erbia does exist; its composition, established by the isomorphism of its sulphate with that of didymium, is that of a protoxide, of which the symbol would be  $\text{ErO}$ ; its atomic weight is approximatively equal to 576. ( $\text{O} = 100$ ) or 95 ( $\text{O} = 16 \text{ H}$ ). It is distinguished from the bases which accompany it in gadolinite by its physical properties, its chemical reactions, its proportional number, and its behaviour with the blowpipe and fluxes.

Yttria is besides mixed with another earth, white, or nearly so, terbia, extremely difficult to distinguish, but which seems, however, to have a different atomic weight.

M. Bahr last year announced the discovery of a new simple body—wasium—extracted from orthite and gadolinite. In a paper published December, 1863, in the *Bibliothèque Universelle (Archives)*, vol. xviii., I proved by experiments the perfect identity of cerium and wasium—in so far, at least, as M. Bahr has described the latter, and he has not since brought forward any fact calculated to weaken this conclusion.

A memoir appeared recently in Germany entitled "Researches on Yttria," by M. O. Popp.‡ The author is thus occupied with the same subject as myself, and he believes he has proved the identity of erbia with oxides of cerium. It appears, moreover, from a passage in his work that M. Berlin regards terbia as a mixture of erbine (the existence of which he admits) and yttria. M. Popp says yttria is a very pale yellow earth, that its atomic weight is equal to 525, and that its nitrate has the property of giving in the spectroscopic absorption lines similar to those assigned by Dr. Gladstone didymium.

All the properties of erbia, such as I have given them above, are opposed to the idea of its being a simple mixture of bodies already known. The methods employed to extract it may very likely be insufficient to free it entirely from yttria, but in the state in which I obtained it it was sufficiently pure to make it impossible to attribute its characteristics to any of its congeners.

With respect to terbia I am as yet undecided on the question of its existence, though certain facts would lead me to agree with Mosander in regarding it as distinct. I hope soon to be more decided upon this point.

In fact, yttria is of a very pale yellow colour, but purified as much as possible it has, according to my researches, an atomic weight much less than that assigned to it by M. Popp; the figure found by me is not positive, not being established by a sufficient number of experiments; but, as it very nearly approaches that formerly found by Berzelius, it may be regarded as very nearly exact.

I examined with the spectroscopic the absorption band mentioned above. With the apparatus at my disposal I was not able to determine the position of the black lines by means of a given scale; my observations were, however, as follows:—

A concentrated solution of nitrate of didymium, containing lanthanum, interposed between the slit of the apparatus and a continuous spectrum flame, shows two beautiful black lines, large, very clearly defined, situated one nearly at the end of the yellow and orange, near the line D, beside C; the other in the bluest part near G. The space between these two lines is shared equally by two groups of two lines, each equally clear, but straighter than the preceding. The first of these groups is in the centre of the green portion, between E and b, the second in the blue, between F and G; it is often accompanied by a seventh line.

Under the same conditions nitrate of erbia manifests slightly different phenomena, the two intermediate groups are replaced each by a simple line; otherwise all the positions and the relative brightness are almost the same. With nitrate of yttria only two fine lines are with difficulty observable; all the others disappear; but, strange to say, the brightest do not remain, and one of them, the largest blue one, disappears.§

A mixture of one-third of didymium and two-thirds of yttria behaves like pure didymium.||

(All the solutions employed were highly concentrated, and contained in round equal tubes of a centimetre in diameter.)

M. Popp has observed five lines with yttria, three of which coincide with those of erbia in the violet, blue, and green; but the position of the fourth is rather

‡ *Annalen der Chemie und Pharmacie*, cxxxi., 179. This memoir contains studies of many new or little-known salts of yttria. We shall give an abstract of this paper in our next number.

§ This, perhaps, accounts for the dimness of this part of the spectrum.

|| This experiment plainly shows that erbia is not a mixture of yttria and didymium.

\* *Archives des Sciences Physique et Naturelles*, Geneva.

† These reactions have been studied chiefly by M. Plantamour.



different. I have not seen the fifth, situated in the outer part of the red.

M. Bahr, of Upsala, discovered the absorption lines of erbia, but I have not seen his memoir.¶

Since writing the above, I have found that the position and relative brightness of the dull lines described by Popp are perfectly exact, but do not belong to yttria, but to erbia, to which they are peculiar. Yttria (or perhaps only terbia) gives two lines—one in the yellow, the other in the green,—which coincide exactly with those of didymium, except that they are much smaller.

#### *Hydrofluoric Acid for the Detection and Estimation of Silica, by M. FRED. KUHLMANN\*.*

THE author proposes to treat silicates at a dull red heat with a current of hydrofluoric acid, and has had made a platinum apparatus adapted for this process. It consists of a platinum retort, of which the belly may be of lead; the acid is produced by means of sulphuric acid and white cryolite, or pure fluoride of calcium. The neck of the retort fits tightly into a tube of platinum which contains, in boats of the same metal, the matter to be analysed; this tube, by means of a short adapter, also of platinum, communicates with a condensing or absorbing apparatus; this apparatus may be of vulcanised india-rubber. One hour suffices for the treatment of 10 grammes of matter, but not more than 2 grammes should be employed. By means of this experiment M. Kuhlmann has ascertained the following facts:—

Amethyst contains no metallic oxide, but soda and potash, which are observed by means of the spectro-scope; emeralds and yellow quartz are decolorised; smoky and yellow diamonds, and rubies do not alter in colour; blue sapphire takes a slightly violet tinge.

Bluedisthène leaves a ferruginous residue with fluoride of potassium and aluminium; tremolite, pyroxene, quartz, and jasper give a residue of potash and soda.

Finally, red cornelian, which had turned to a dead white under the influence of oxidising and deoxidising gases, and the colour of which seemed consequently due to an organic matter, was found to be ferruginous, which proves that if oxide of iron enters into the colour of cornelian, it is by reason of a peculiar molecular arrangement, which disappears by calcination under the influence of reducers or oxidising gases.

#### *The Estimation of Fluorine in Phosphates of Iron and Manganese;† by H. VON KOBELL.*

THE method proposed by the author for estimating fluorine in combinations easily attacked by sulphuric acid is as follows:—Cover the platinum capsule in which the decomposition takes place with a funnel, resting with the capsule on a platinum basin, on which it is fastened with wet plaster; ascertain the weight of the funnel and the composition of the glass of which it is made. Heat the whole until most of the sulphuric acid has been expelled; then raise the funnel, wash it carefully, dry and weigh it; the decrease in its weight is owing to a portion of the glass having been attacked; and as its composition was first ascertained, the weight of silica which has been attacked may be calculated from the decrease in weight, and, consequently, the quantity of hydrofluoric acid which has been disengaged.

This method has given very satisfactory results with triplite of Limoges, and with zivieselite, and other analogous phosphates of Schlaggenwald. With fluoride of calcium and cryolite too little fluorine is found, because the decomposition of these minerals is complete only when the mixture is properly shaken, which is difficult with the apparatus described above. The same funnel may be used many times, and is even better after it has been corroded; the author has made it in the form of a receiver, that it may better cover the capsule.

If the substance to be analysed contains silica, the quantity must be ascertained and added to that of the glass attacked, to obtain the weight of fluorine.

The author has experimented by another method. Place the substance to be analysed in a rather deep platinum crucible, and cover it with three or four times its weight of silica; add a few drops of sulphuric acid, and heat gently for half-an-hour; then gradually increase the heat until most of the sulphuric acid is expelled. Then treat the whole with hydrochloric acid, add some water, and leave it to deposit; collect the deposit, calcine, and weigh it, and the loss of silica will indicate the amount of fluorine contained in the substance analysed (38 of fluor corresponds to 30 of silica).

The author analysed the Limoges triplite by both these methods, and found in them from 6.8 to 7.5 per cent of fluor. The heterosite of Limoges contains only 0.902 per cent.

The qualitative research of fluorine in substances free from silica is easily made, with small quantities of matter, in a platinum crucible furnished with a lid, with a small circular hole pierced in the centre, above which a disc of glass is placed.

### PHYSICAL SCIENCE.

#### *On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood stains,‡ by H. C. SORBY, F.R.S., &c.*

(Continued from page 188.)

I trust I have now made the general arrangements sufficiently intelligible, and will proceed to describe some of the objects to which the instrument may be applied.

**Detection of Blood-Stains.**—Passing from these almost purely scientific questions, I will now describe the application of the spectrum microscope to a very practical subject, viz., the detection of blood stains in criminal inquiries. The optical properties of blood have been described by Hoppe,§ and in still greater detail by Professor Stokes.|| Hoppe suggested that the peculiar and characteristic spectrum of fresh blood might be employed as a test, but the plan he proposed was to moisten the blood-stain with water and examine it direct, which of course could not be done if it were on a highly-coloured fabric. Professor Stokes also suggested that the spectrum of deoxidised hæmatin might be employed for the purpose, but did not further develop the subject, being evidently desirous to investigate it chiefly in relation to chemistry, optics, and physiology. However, in considering the question, I soon became convinced that it deserved a most careful study, with special reference to the detection of minute traces of blood in criminal investigations, and therefore have directed a great amount of attention to that point alone. Such inquiries almost necessarily fall into the hands of a microscopist; and,

¶ See *Ann. der Chemie und Pharmacie*, cxxxi., 256.

\* *Comptes Rendus*, lviii. 548.

† *Journal für Praktische Chemie*, xcii., 385, 64.

‡ From the *Quarterly Journal of Science*.

§ Virchow's *Archiv.*, vol. xxiii. (1862), 446.

|| *Procédés of R. S.*, xiii. (1864), 355.



as I shall show, the apparatus I have described will enable any one to detect with certainty most marvellously minute traces of blood when the usual methods would entirely fail. That merely chemical tests are generally suspicious, and often not to be trusted at all, is freely admitted by my friend Dr. Allan, who has had much experience in such inquiries; and, of course, if the red globules have been destroyed, the microscope alone is of little or no use. In such cases the method I now propose comes to our aid, and enables us to detect as small a quantity as  $\frac{1}{1000}$ th of a grain of the colouring matter of blood left on a fabric from which apparently all traces have been washed, or which only shows a slight discoloration. If all has been washed out, its detection is no longer possible, for it is this colouring matter itself, and not any action on the material, that proves the former presence of blood.

Since in studying the spectra of blood it is important to be able to operate on small quantities, I have employed cells, cut from a barometer tube, having an external diameter of about half an inch, an internal diameter of one-eighth, and half an inch long, slightly polished at both ends. These may be fixed with Canada balsam in the centre of pieces of glass about 1.6 square, or, what is still better, in the centre of the longer side of triangular pieces, formed by cutting such squares along a diagonal, so that two may be placed side by side in front of the slit, and the spectra of two solutions compared together at one view. Liquids can be readily introduced into such cells by means of a moderately stout platinum wire; and when rather more than full, so that a little spreads over the top of the cell, a piece of thin glass can be easily put on without inclosing any bubble, and the surplus removed with blotting-paper. Capillary attraction keeps the glass on, and evaporation takes place so slowly that everything remains for a considerable time in a proper condition; and if desirable, the glass may be fixed on by means of gold size, and the solution kept for weeks. Placing such a cell in front of the slit, as at *a* in Fig. 1, the light passes through the thin glass at the top, through the column of liquid and the thick glass at the bottom, and then through the narrow slit to the prism. Cells of less diameter than one-eighth of an inch might be used, but it is difficult to fill and empty them. Even when one-eighth in diameter, if it be requisite to transfer the solution to a watch-glass it is well to have a piece of such tube as is used for spirit thermometers, drawn out at one end and bent at a right angle, so that it may be introduced to

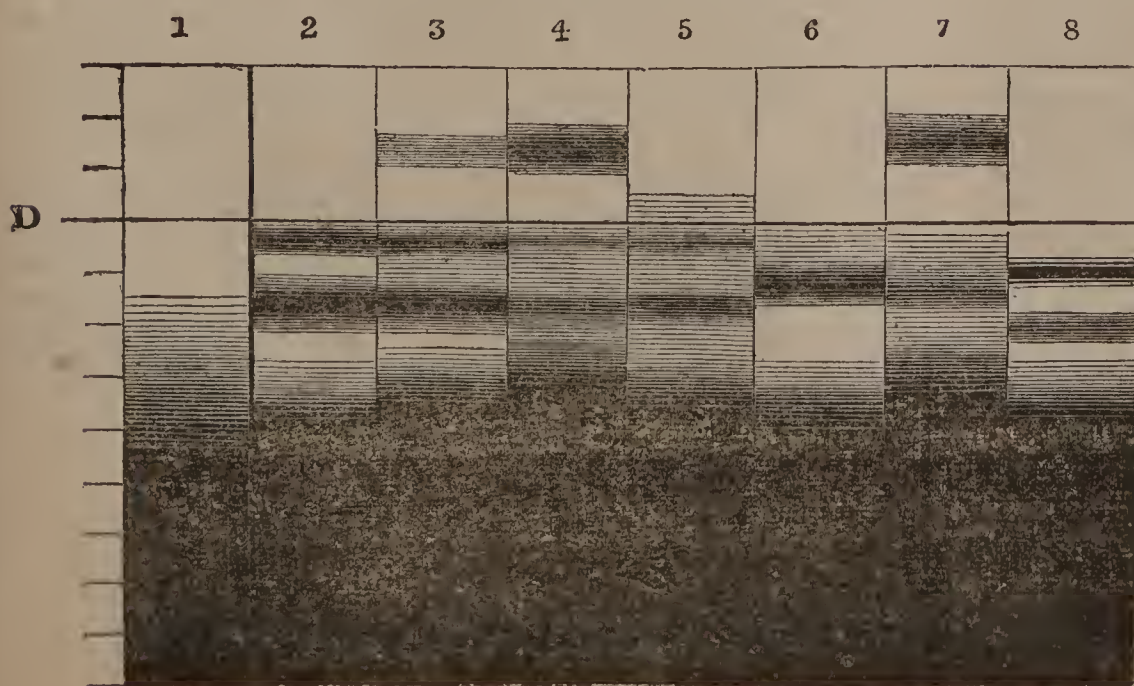
the top of the cell, and the liquid removed by blowing down the tube.

The exact position of the dark absorption bands in the spectra obtained from blood being a very important character, it is necessary to make use of the micrometer; and I have found that for this purpose it is well to arrange the instrument so that the width of the entire spectrum is about 12, as shown by the divisions on the left-hand side of Fig. 2. I shall adopt this method of measurement in all my descriptions. Gas-lamp light is, if anything, better than daylight, because the line C of Fraunhofer interferes with the correct determination of some facts. Turning a wire holding common salt into the flame, the bright yellow sodium line is seen; and one of the principal lines of the micrometer having been made to bisect it, the wire is turned out of the flame and the measurements made.

Since human life might depend on the accurate determination of the facts, I shall describe all the characteristic peculiarities of the spectra, so as to avoid, as far as possible, any serious mistake. If a piece of linen, one-eighth or one-tenth of an inch square, soaked with blood, and quite recently dried in pure air, be digested in a few drops of water in a watch-glass, it yields a solution, which, when introduced into one of the cells just described, produces a spectrum like No. 2 in Fig. 2. The blue end is quite absorbed, and so are two bands in the green, but the whole of the red end is transmitted. When the solution is stronger the absorbed portion of the spectrum increases upwards, and the dark bands in the green become broader, until the whole of the light below D is absorbed, and merely a bright red remains above it. If examined when the yellow sodium line is present a narrow dark band is seen just above it, even when the spectrum is like No. 2, and shows no such dark band in that position with the natural light. On diluting the solution the bands in the green become more and more narrow and faint, but do not disappear until it is so dilute that the blue end of the spectrum is transmitted without sensible alteration. Since the width of the bands varies with the strength of the solution, the position of their edges is not constant, though that of their centre is nearly so, and will be given in the following descriptions. However, it is somewhat difficult to determine it with great accuracy on account of the gradual shading off on each side, which, of course, can be only imperfectly represented by a woodcut. Taking the whole spectrum at 12, the centre of the upper band is at  $\frac{1}{3}$  or .4; of the lower,  $1\frac{2}{3}$ ; and of the green

between them, 1. The upper band has a sharper outline, and, when so much blood is present as to cut off about  $\frac{1}{2}$  of the spectrum, its width is about  $\frac{2}{5}$  that of the lower, as shown by No. 2. As a good example of an entirely different spectrum, given by a solution of very similar colour, I refer to No. 1, which represents that of a dilute solution of perchloride of iron to which a little sulphocyanide of potassium has been added. In its case the blue end of the spectrum is more and more absorbed, according to the strength of the solution, but no narrow dark bands are formed in any part. The spectra of many red colouring matters have this character, and therefore could not possibly be confounded with blood. Cochineal does, indeed, yield an absorption band in the same position as the lower in fresh blood, but it is ex-

FIG. 2.—BLOOD SPECTRA.





tremely faint, and there is none where the upper band occurs. A second does exist, but it is  $3\frac{1}{2}$  below D, and is seen only when the solution is so dilute that the blue part of the spectrum is freely transmitted. On adding ammonia to the solution of cochineal, two absorption bands are produced in such a position that without care they might be confounded with those of blood; but the upper is decidedly broader than the lower, whilst it is the reverse in blood; and its centre is also lower, being  $\frac{1}{2}$  and not  $\frac{1}{3}$  from D. A solution of cudbear in dilute alcohol also yields two very faint bands in much the same place as those in fresh blood, but on adding ammonia the band at  $\frac{1}{2}$  becomes very dark and distinct, and the lower band vanishes. The addition of ammonia to a solution of fresh blood produces no such changes.

The gravy of roasted meat gives different spectra according to circumstances. The red liquid which comes from it when undercooked is merely a solution of cruorine, and gives the same spectrum as fresh blood; but the usual light or darker brown liquid sometimes gives a dark and sharply-defined absorption band at about  $1\cdot4$  below D, and suddenly cuts off all the rays below  $2\frac{1}{4}$ . The addition of ammonia causes a precipitate, but leaves an obscure band in the same situation. Citric acid removes the band entirely, but ammonia in excess restores it without causing a precipitate, and the addition of protosulphate of iron produces no change. When dried and strongly heated the colour becomes darker, and it merely cuts off more or less of the blue end of the spectrum, as in No. 1, without there being any detached absorption bands. Probably this is why dark-coloured gravy often has that character. Thus, though, as far as tests are concerned, the chemical composition is almost identical with that of blood, the optical characters and the manner in which gravy behaves with reagents suffice to distinguish it, unless it be from meat so extremely underdone that it is, in fact, merely more or less modified blood.

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, April 20.

Professor W. A. MILLER, M.D., F.R.S., President,  
in the Chair.

THE minutes of the previous meeting were read and confirmed, and the contributions to the Society's library were announced and acknowledged. The following gentlemen were formally admitted Fellows of the Society, viz.:—Capel H. Berger, R. H. M. Bosanquet, Alexander W. Gillman, W. White Rouch, and John F. Walker, Esqs. The names of the following candidates were proposed for the first time, viz.:—Thomas Fairley, Medical School, Leeds; Edward Swann, Director of the Laboratory of the London and North-Western Railway Company, Crewe; Alfred Upward, Superintendent of the Chartered Gas Company's Works, 148, Goswell-street, London. For the second time were read the names of Dr. Holzmann, Marlborough House; Mr. Thomas C. Kirkham, Gilston Road, West Brompton; and Mr. Joseph Sugden, Jun., Trinity House, Halifax. The names of Mr. Arthur Clegg Bowdler, Oxford Road, Manchester, and Mr. W. E. Heathfield, F.R.G.S., Princes Square, Finsbury, were read for the third time, and, the ballot having been taken, these gentlemen were declared to have been duly elected Fellows of the Society.

Professor CHARLES L. BLOXAM read a paper "*On the Action of Hydrosulphate of Ammonia upon Freshly-precipitated Sulphide of Copper.*" Referring to the well-known

fact of sulphide of copper being appreciably soluble in yellow or colourless hydrosulphate of ammonia, the author had undertaken experiments for the purpose of demonstrating the nature of the soluble compound thus formed. The results led to the discovery of a peculiar double sulphide of copper and ammonium which does not appear to have been previously described. For its preparation some recently precipitated and well washed sulphide of copper (obtained by passing sulphuretted hydrogen through aqueous sulphate of copper) was boiled for a short time with colourless monosulphide of ammonium, or with the yellow product obtained by saturating the last-named compound with sulphur. In both cases copper was taken into solution, but the latter condition was that which favoured the production of the desired compound, and when a solution of this kind was set aside for a few hours in a well-closed bottle it deposited splendid crystals of a vermilion-red colour, which assumed the form of tufts of needles, and were very similar to chromic acid. These crystals underwent partial decomposition even when washed with cold water, and by boiling furnished a dark green precipitate of sulphide of copper. Upon adding hydrochloric acid to the yellow solution of the double sulphide an orange coloured precipitate was obtained so nearly resembling the ordinary appearance of sulphide of antimony that the author conceived it might often be mistaken for this substance, and hence the necessity of confirming the presence of antimony by independent tests. By drying the vermilion-red crystals over oil of vitriol the author succeeded in preparing a sample sufficiently pure for quantitative analysis, but they were immediately decomposed by the heat of the water-oven, evolving an ammoniacal odour and turning black from the separation of sulphide of copper. Hydrochloric acid did not act upon the crystals in the cold, but when heated much sulphuretted hydrogen was disengaged and a black residue left. No separation of sulphur was perceptible. Nitric acid was also without action upon the crystals until heat was applied, when violent oxidation took place and much sulphur was separated. The analysis of the compound was effected by boiling a weighed quantity of the crystals with concentrated nitric acid until the separated sulphur assumed the form of pure yellow globules, which were collected and weighed. The sulphuric acid in solution was then precipitated by chloride of barium and the sulphate of baryta also collected and weighed, in order to furnish an indication of the amount of sulphur which had been dissolved. The excess of baryta having been precipitated by sulphuric acid, the copper was determined in the filtrate by boiling with potash and weighing as oxide of copper. For the estimation of ammonia a separate portion of the crystals was boiled with hydrochloric acid until completely decomposed, removing the small quantity of copper which entered into solution by passing a current of sulphuretted hydrogen; the filtered liquid was then carefully evaporated to dryness, and the resulting chloride of ammonium weighed. From the observation that sulphuretted hydrogen was evolved by the action of hydrochloric acid upon the red crystals the author inferred that the ammonia was associated with an atom of hydrogen, and it was therefore calculated as  $\text{NH}_4$ . Two samples were examined in this manner by Professor Bloxam, the one having been dried over oil of vitriol and the other by pressure between folds of bibulous paper. The resulting numbers indicated the formula—



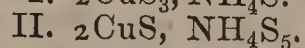
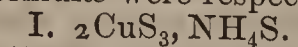
as will be seen by the following comparison:—

	Theory.	Experiment.	
Copper . . .	32·81	32·65	32·11
Sulphur . . .	57·88	58·07	59·07
Ammonium . .	9·31	9·07	8·82

\*  $\text{Cu} = 31\cdot7$ .  $\text{S} = 16$ .  $\text{NH}_4 = 18$ .



The author explained that the divergence between the numbers demanded by theory and those obtained in different experiments was not greater than would be expected in dealing with a compound of so decomposable a nature. Speculating, then, upon the constitution of the substance under examination, it was stated that the two simplest rational formulæ were respectively—



And, whilst the mode of production seemed to favour the latter expression, the author preferred to adopt the first formula, chiefly because there was no sign of sulphur being separated from the compound by the action of hydrochloric acid; secondly, because of the failure of concentrated nitric acid to split up the red substance in the cold; and, lastly, this view was supported by the action of heat upon the crystals. The author gave his opinion in favour of the use of yellow sulphide of ammonium, instead of the corresponding potassium compound, for the purpose of separating copper from the other metals of the sulphuretted hydrogen group in the prescribed method of qualitative analysis, inasmuch as it would be found easier to identify copper in the presence of the metals forming sulphur acids (*e.g.*, antimony, tin, and arsenic), than in searching for it in a mixture of the basic sulphides (*e.g.*, those of bismuth and lead), when its detection presented greater difficulties, especially to an inexperienced analyst.

Professor BLOXAM then proceeded to read an interesting communication entitled "*Notes upon the General Routine of Qualitative Analysis for Metals.*" The first point referred to related to the reduction of bin oxide of tin by fusion with cyanide of potassium; the author found that the presence of sulphate of potash as an impurity in the ordinary commercial quality of the cyanide of potassium entailed a loss of tin in the reduction of the metal. This error was traced to the formation of sulphide of potassium, which united with an equivalent proportion of sulphide of tin, and rendered it soluble in water when the fused mass was acted upon by that liquid. According to the amount of sulphate originally present in the flux, the black stannous sulphide  $\text{SnS}$ , or the yellow stannic sulphide  $\text{SnS}_2$ , would be formed; but in either case the addition of hydrochloric acid in slight excess to the aqueous solution determined the separation of the whole of the dissolved tin. Upon fusing 10 grains of pure bin oxide of tin with 50 grains of the commercial cyanide, the globule of reduced metal weighed 7.1 grains instead of 7.8 grains; and on treating the slag with hot water a considerable quantity of black stannous sulphide was recovered, the solution itself giving but a slight yellow precipitate with hydrochloric acid. On repeating the experiment with the same proportions as before, but with the addition of 5 grains of sulphate of potash, the globule of tin weighed only 6.6 grains, and the aqueous solution furnished an abundant yellow precipitate of stannic sulphide when mixed with hydrochloric acid. Since in the final confirmation of the presence of tin it is usual to fuse the supposed bin oxide with cyanide of potassium, it is important, when using the commercial salt, to examine not only for metallic tin, but for any black sulphide separating during the solution of the fused mass in water, and for any yellow sulphide which may exist in the aqueous solution. Instead of using cyanide of potassium, the ferrocyanide answers the purpose for reducing the stannic oxide, an alloy of tin and iron being obtained which dissolves in hydrochloric acid, and responds to the test with mercuric chloride.

*Detection of Zinc in Qualitative Analysis.*—The zinc precipitates are all white, and the well-marked characters of the sulphide are so easily obscured by the presence of traces of foreign metals, that the detection of this element is often surrounded with practical difficulties; and even if the coloured reaction with nitrate of cobalt on charcoal

be resorted to, as a confirmatory test, the indications are, from the same cause, not always deemed satisfactory. The author recommends a modification of the ordinary course of analysis to meet such cases; the supposed sulphide of zinc is dissolved off the filter with hot dilute nitric acid, and the solution is mixed with a very small quantity of nitrate of cobalt (not even sufficient to impart a pink colour), the whole is then precipitated by carbonate of soda employed in slight excess, boiled for a minute or two, and the product collected on a filter, washed, dried, and incinerated on platinum foil. The green colour, if not already apparent, becomes visible upon crushing the residue moistened with a little water under a glass rod. By quantitative experiment it was demonstrated that sulphide of ammonium is a more sensitive reagent to be employed in the detection of zinc than the ferrocyanide of potassium, and that by this means  $\frac{1}{100000}$ th part of zinc in solution can be identified.

*Detection of Magnesium.*—When proceeding to test for magnesium in the filtrate from the ammonia and sulphide of ammonium precipitates in the ordinary course of analysis, it is usual to add phosphate of soda, and look for the formation of a crystalline precipitate of the ammonio-magnesian phosphate, but frequently a slight flocculent precipitate makes its appearance at once, and obscures the magnesian reaction. The author asserts that this is phosphate of alumina, and its occurrence in this place (not alluded to in treatises upon qualitative analysis) is due to the slight solubility of alumina both in ammonia and sulphide of ammonium.

*Mineral Constituents of Filter Paper.*—The errors from this source may frequently be disregarded, but in critical analyses where the solutions operated upon have to be many times subjected to processes of filtration, and possibly a whole sheet of paper thus consumed, it is desirable to take these matters into account. The author made a careful analysis of a large quantity of the ash of an ordinary quality of white filtering paper, bearing the name of "J. McA. and Co.," and found it to consist chiefly of silica and alumina (clay), with smaller quantities of the carbonates of lime and magnesia, and ferric oxide. There were also present the sulphates of lime, potash, and soda, and traces of phosphoric acid, oxide of cobalt, and oxide of lead. It is usual to make an allowance for the weight of the ash in quantitative analysis, and the author believes it to be equally necessary to make an examination of the mineral constituents of the paper before employing it in exact qualitative analyses.

A short discussion ensued, in which Dr. ODLING stated his conviction that the formula adopted by Prof. Bloxam, in explaining the constitution of the cupr-ammonium sulphide, was at variance with all the analogies of sulphur. It was not possible for the compound to contain an uneven number of sulphur-atoms, and he regretted that a physical examination of a substance of this character could not be made, but in other instances, where such corroboration could be readily obtained, it had been found that the vapour-volume and specific heat supported the di-equivalent value of this element.

Professor BLOXAM admitted that his sulphur determinations were not so close as he should have wished, but for the eight-atom formula (instead of  $\text{S}_7$ ) the amount of 61.12 per cent. of sulphur was demanded.

The PRESIDENT offered a few observations upon the general question of nomenclature, and proposed a vote of thanks to Prof. Bloxam, which was warmly responded to. The meeting was then adjourned until Thursday, May 4.

## PHARMACEUTICAL MEETING.

Wednesday, April 5.

Mr. T. H. HILLS, Vice-President, in the Chair.

MR. HASELDEN read a paper "*On Resina Jalapæ, P. B.*" The author prepared the resin both from sound and worm-



eaten root, and found that the sound root yielded the largest amount, thus disproving the assertion of Christison and Pereira that the worm-eaten root is the best for the preparation of the resin. He also experimented upon Tampico as well as Vera Cruz jalap, and found that the former yielded as much resin as the latter. When methylated spirit was employed in making the extract the author found that it was impossible to get rid of the disagreeable methylic odour. The sulphuric acid test, he showed, would not distinguish between scammony and jalap resins, both giving a rose colour.

Mr. TILDEN remarked that Spirgatis had recently shown that the resins of jalap and scammony give the same colouration with sulphuric acid, and that their chemical properties resemble each other so closely as to lead to the conclusion that the active principles are identical—a conclusion which is supported by the fact that the plants yielding them belong to the same natural order.

Professor REDWOOD then read a paper "*On the Construction of a Pharmacopœia.*" The Professor objected to the division of the Pharmacopœia into two parts, one containing the Materia Medica, and the other the preparations and compounds. He suggested the amalgamation of the two parts, as made in several foreign pharmacopœias, in which all the articles ordered, excepting those used as tests and reagents, are arranged in alphabetical order, and included in one category. The adoption of this arrangement would bring all preparations of a sort together, just as they are at present. But besides this classification under the respective heads *Aquæ*, *Cataplasmata*, &c., there is another, very important to the medical man, which is to have appended to every medicine a list of the preparations into which it enters. Thus, under the first article, gum acacia, we should have

*Preparations containing Gum Acacia.*

Mistura Guaiaci . . . . .	1 part in 85
Mucilago Acaciæ . . . . .	1 part in 2½
Pulvis Amygdalæ compositus . . . . .	1 part in 13
Pulvis Tragacanthæ compositus . . . . .	1 part in 6
Etc., etc.	

With regard to the nomenclature used, the Professor said it should be as far as possible adapted for all time, and if once established should not be rashly changed. A pharmacopœia, he thought, should occupy neutral ground with reference to chemical theories, and the use of chemical names and symbols be as far as possible avoided. Referring to the mercurial compounds, calomel and corrosive sublimate, he remarked that the amount of chlorine combined with the mercury in these bodies was twice as great in one case as in the other, and thus a simple relationship between the two bodies was established. The name subchloride, applied to calomel, indicated its position among the chlorides of mercury, as containing the smaller proportion of chlorine. It is preferable in this respect to the name chloride, as being more explicit, and leaving no doubt as to which of the chlorides is meant. He suggested also that the name "*Hydrargyri perchloridum*" should be applied to corrosive sublimate, the prefix "*per*," as used in such a case, being perfectly well understood to signify the compound containing the largest proportion of chlorine. In the case of the protoxide of mercury, the Professor advocated the use of the name "*Hydrargyri oxidi rubrum*," a name which would be good for all time. After referring to the difficulties at present in the way of assigning absolute formulæ to chemical compounds in general, the Professor proceeded to the consideration of the weights and measures employed, and remarked that while the adoption of the avoirdupois weights is likely to produce a more uniform and correct preparation of the medicines in large quantities, the old apothecaries' weights are much better adapted for prescriptions. The quantities represented by these weights, and the relations they bear to each other, are, if not the best that could be devised, at

least the best that have been introduced or suggested. They are easily written, perfectly characteristic, and readily distinguished, not only from each other, but also from other parts of the writing of a prescription. In continuation, the Professor advocated the extended recognition of well-established forms of remedies in a pharmacopœia. He suggested that, among "*granular*" and effervescent medicines, for example, whatever is good and essential should be sought out from among the varied extrinsic qualities given to such preparations for mere trade purposes. The form of lozenge he thought promised successful extension for giving an agreeable character to medicines; and for external remedies he thought plasmata might often replace ointments. He suggested, however, the name "*Glycemata*" instead of plasmata. Thus the original preparation of starch would be *glycematum amyli*, which he would shorten to *glycemylum*, and other solutions in glycerine would receive a similar name. The use of glycerine as a solvent he thought might be advantageously extended in medicine.

Owing to the lateness of the hour only a short discussion followed the reading of this important paper—important as, perhaps, foreshadowing some of the alterations that may be looked for in the edition of the Pharmacopœia—or, rather, new Pharmacopœia—now in preparation.

Dr. W. S. SQUIRE objected to the arrangement proposed by Dr. Redwood. He thought the best arrangement was that in which the descriptions of all the preparations of an article were given in connexion with the article itself. This was the arrangement in the "*Companion to the Pharmacopœia.*" He wished chemical symbols and formulæ to be retained, and differed entirely from the Professor on the subject of weights and measures. The introduction of new substances, he thought, involved considerable difficulty, and he objected to Plasmata, as they would not mix with ointments.

Mr. D. HANBURY said that there were two classes of people who were greatly interested in a Pharmacopœia—namely, physicians and pharmacutists, who desired to know the composition of medicines, and the best methods of preparing and identifying them. The object of the work was to supply this information to these two classes of persons, and he thought it undesirable to introduce extraneous matter. The Pharmacopœia was not intended to be a work for teaching chemistry, and still less botany and zoology, but for giving the necessary instructions for the preparation of medicines in the best, most efficient, and economical way; and the information given should be conveyed in plain language, that could be readily understood by those who had occasion to refer to it.

Drs. EDWARDS and ATTFIELD both expressed an opinion that the Pharmacopœia should indicate what system of chemistry was recognised, so that teachers of pharmaceutical students might know what course to pursue.

The meeting (the last of the season) then adjourned.

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 4th, 1865.

R. ANGUS SMITH, *Ph.D., F.R.S., &c., President, in the Chair.*

A COMMUNICATION was read entitled "*An Instance of the Injurious Action of Alkalies on Cotton Fibre*," by Messrs. Heinrich Caro and William Dancer. A remarkable instance of the deleterious action of alkali on cotton fibre has lately come under our notice, when examining some indigo prints which had been stiffened or finished with silicate of soda, and kept in bales during about two years. The strength of the fibre of the greater part of these goods had decreased to about one-third of the strength of some pieces which had been packed in the same bales, and which differed in no other respect from the others except in their



having been finished with starch. We therefore surmised that silicate of soda had been the primary cause of the deterioration of the goods. Further observations convinced us, however, that the injury was due to the long-continued action of free or carbonated alkali upon the cotton fibre. Some of the sound pieces (which, as before mentioned, had been finished with starch) had been packed between the silicated goods, and had abstracted soda from them, which had penetrated from the places of contact into the interior of the pieces to a considerable depth. In the same ratio in which the pieces had taken up soda it was found that they had diminished in strength. On the other hand, it was found that in such places of contact the silicate of soda of the silicated goods had suffered a partial decomposition, extending to the depth of four or five layers of the pieces. The silicate of soda in the middle of the pieces contained from 70 to 74 per cent. of silicic acid, combined with from 30 to 26 per cent. of soda; whilst the analysis of the silicate of soda contained in the contact layers showed that from one-third to two-thirds of its soda had been abstracted. This loss of soda was accompanied by a change of strength of the cloth which appeared to bear some proportion to it; the layers or folds of the cloth *decreasing* in strength as they were removed from contact with the starched goods, until the silicate of soda attained the same composition as that found in the most rotten parts of the piece, this generally taking place about the fourth or fifth layer or fold of the piece, as before stated. The following table shows the changes in strength produced by this decomposition of the silicate of soda:—

Finished with Starch.			Finished with Silicate of Soda.					
	Middle.	Contact Layer.	Contact Layer.	2nd	3rd.	4th.	5th.	Middle.
Strength ..	100	81	89	68	62	54	48	35

The silicate of soda had evidently been decomposed with the formation of free alkali and an acid silicate which appears to have very little action on the cotton fibre. In some places the decomposition had gone further, and free silicic acid had separated out in the form of a white powder upon the surface of the cloth. The same decomposition, accompanied by the same changes in the strength of the cloth, was observed upon all pieces which had been in contact with the paper used for wrapping the bales. In this instance the paper had absorbed the liberated soda, and the cloth in contact with it had almost entirely retained its original strength. The white portions of the patterns were in a further advanced state of decay than the blue ones, in most instances retaining only 10 per cent. of their original strength. In the goods finished with starch only, the whites were equally as strong as the blues. In the goods finished with silicate of soda the whites were almost as strong as the blues in all places where the before-mentioned decomposition of the silicate of soda had been accompanied by an abstraction of soda; but in the interior of the goods, where the silicate of soda had retained its original composition, the strength of the whites had decreased to about one-third of that of the blues. It was therefore evident that this excessive decay of the whites was due to some cause which had assisted the action of the alkali upon them, and we believe to have found an explanation of this in the action of the silicate of soda upon the sulphate of lead contained in them to the amount of about 10 per cent. of the mineral ash. Sulphate of lead has been an ingredient of the resist paste printed upon the places intended to remain white, and by the subsequent action of lime and sulphuric acid it has become fixed in the fibre. We have noticed that sulphate of lead decomposes solutions of silicate of soda very rapidly, with formation of sulphate of soda, free silicic acid, and silicate of lead. These changes give rise to the production of a crystallisable and strongly efflores-

cent salt, and to an increase in bulk; and we think that the mechanical effect produced by the crystallisation of the sulphate of soda formed may have caused a further and final disintegration of the fibre already weakened by the action of the alkali. Under the microscope the fibre of the white portions of the pattern presented the appearance of cylindrical tubes, partially covered with minute crystals (soluble in water); in some places these tubes appeared to be split longitudinally. A paper on the same subject was lately read before the Chemical Society of London by Dr. F. Crace Calvert, F.R.S. (See CHEMICAL NEWS, p. 113.)

A paper, entitled "*Remarks on the Microscopical Appearances of Cotton Hair During Dissolution in the Ammoniacal Solution of Copper*," was read by J. B. Dancer, F.R.A.S. The structure of cotton hairs has occasionally furnished an interesting topic for conversation at the meetings of our Microscopical Section. Two of our members, Mr. Chas. O'Neill and Mr. Heys, have given considerable time and attention to this subject. Mr. Walter Crum, F.R.S., communicated to the Chemical Society a memoir "*On the Cotton Fibre*," and the manner in which it unites with colouring matter. His paper is illustrated with some beautifully executed drawings of the microscopical appearances of cotton in the natural state, and when mordanted, mercerised, and treated with various dyes; this paper is well worthy the attention of those interested in this branch of inquiry. Mr. Crum has presented a copy of his memoir to this Society. His description of the ordinary appearance of the cotton fibre agrees so nearly with what I believe it to be, that I will take the liberty of referring to his printed paper.\* To Mr. Crum's description I may add, that many specimens of cotton, especially on the cylindrical portion of the hairs, show traverse markings. At times these appear at tolerably regular intervals, they have been claimed as evidences of spiral structure; when, however, they are examined with magnifying powers of 1000 to 1200 diameters, they proved to be cracks in the external membrane. Other portions of cotton exhibit longitudinal furrows, irregular in length and direction, having a shrivelled appearance something like the bark of an aged tree. In gun-cotton the transverse cracks are very numerous. From an examination of transverse sections of cotton I incline to the opinion that there is an external membrane distinct from the true cell wall or cellulose matter. Inside the cellulose there is an irregular cavity. This, in some specimens (when viewed longitudinally), appears to contain granules, probably the remains of the organising fluid contents of the cell—the mucous matter which is seen in growing cotton as mentioned by Captain Mitchell in his letter to Mr. Hurst read at this Society March 22, 1864. On April 21, 1863, Mr. Chas. O'Neill made a communication to this section "*On the Appearance of Cotton Fibre during Solution and Disintegration*."† These experiments referred to the application of Schweizer's solution of copper and ammonia. Under the action of this solvent Mr. O'Neill considers that cotton exhibits spiral vessels situated either inside or outside the external membrane. In a paper read by the same gentleman on May 18, 1863, it is stated that spiral vessels are seen during the solution of gun-cotton in ether and alcohol. On December 21, 1863, Mr. Heys read a paper before this section, in which he refers to spiral vessels in cotton hairs which seem to prevent the collapse of the tubes. The announcement of the discovery of spiral vessels excited my curiosity. Having often examined varieties of cotton under the microscope without suspecting any such structure, I was naturally desirous of witnessing its appearance during dissolution. A careful examination of cotton in the copper solvent, with powers varying from 50 to 1200 diameters, showed me the appear-

\* *Journal of Chemical Society*, p. 404, vol. i., series 2.

† CHEMICAL NEWS, vol. vii., p. 223.



ances described by Mr. O'Neill. I could not, however, endorse his interpretations of them. On January 16, 1865, I sent a letter to the Chairman of the Microscopical Section, stating my belief that the spiral appearances could be clearly traced to a mechanical action which the solvent exerted on the vegetable cell, and that at some future time I hoped to illustrate this to the members of the section. Since December last I have subjected cotton during microscopical examination to a variety of influences in acids, alkalies, metallic solutions, iodine, and also gun-cotton in varied proportions of ether and alcohol. Repeated experiments tend to confirm my disbelief in the existence of spiral vessels, properly so called, either inside or outside cotton hairs. It would be difficult to explain by means of drawings how these pseudo-spirals are created, and I have, therefore, supplied a number of microscopes for the purpose of showing at the close of the meeting the actual appearances. Some of the gentlemen present have witnessed these experiments; but for the benefit of those who have not I shall attempt a brief explanation, to enable them to comprehend more readily what they will see under the microscopes. In order to observe the action of the copper solvent on cotton, place a few hairs about a quarter of an inch in length on a glass plate, and cover them with thin glass; it is useful to rub a little beeswax on the glass plate in such a manner as will just support the covering glass to prevent too great a pressure on the cotton; then arrange the cotton under the microscope with a power of not less than 200 diameters. The solvent should be applied by a glass pipette to the edge of the covering glass whilst the observer is looking through the microscope (this is important). If the solvent is very strong, the action is too rapid for the eye to follow; if of moderate strength it will be seen that as soon as the solvent comes into contact with the cotton in the field of view, a rapid rotation or twisting of the hairs takes place. In my opinion, it is this rotating action which brings about the appearances which have been mistaken for spiral vessels. The explanation which I have to offer for the phenomenon is this: first, we have the external membrane of the cotton, then the cellulose and primordial utricle, and finally, the dried contents in the cell, which I take to be the remains of the organising fluid. Observation shows that the external membrane is not elastic and only partially soluble. The cellulose is exceedingly elastic and soluble, and expands to a remarkable degree in the act of dissolution. The contents of the cell behave in a similar manner to that of the external membrane; it is neither elastic nor very soluble. The most successful experiment is made by allowing the copper solvent to come at once into contact with some length of the cotton hair. The solvent permeates some parts of the external membrane more easily than others, and causes a rapid expansion of the cellulose, which bursts the external membrane, and as this action is taking place at various portions of the same hair a tangential force is exerted which twists and contorts the cotton in the direction of its length, and thus a spiral appearance is given to the whole structure of the cell. The non-elastic external covering is twisted round the expanded cellulose, sometimes as a single band, at others like a bundle of fibres. In those parts where the external covering has given way all round the hair, the cellulose expands into a bulb, pushing back the external membrane into a series of folds which form a ligature, and resists the expansive force of the cellulose. A number of these ligatures cause the expanded cellulose to assume the appearance of a string of beads. The lateral expansion of the cellulose contracts the length of the hair, and this causes the contents in the cavity of the cell to assume a corrugated appearance; this corrugation has also been subjected to the twisting power along with the other parts of the cell, and thus its spiral appearance is produced. What becomes of the primordial utricle, I cannot state with certainty. After the disappearance of the cellulose there is an enve-

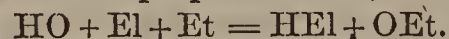
lope left, which surrounds the contents of the cavity, this may be the primordial utricle, or the film left by the drying up of the protoplasmic or organising fluid. If the solvent is made to come into contact with the ends of recently-cut cotton a beautiful trumpet mouth is produced—the exposed surface of cellulose has expanded and pushed back the external covering into folds—the contents of the cell may, in this case, be seen projecting from the mouth of the trumpet form. Long after the complete dissolution of the cellulose has taken place, the external membrane remains just as the rotation or twistings had left it, some portions in the form of rings, which had been the ligatures between the bulbous expansions, other portions as irregular spirals. The cell contents also remain as twisted corrugations. From the observed difference in solubility between the cellulose and the external and internal matter, I should imagine a difference in constitution. A few experiments have led me to suspect that some of the spiral appearances observed in hemp and flax fibres during dissolution may possibly be caused by the mechanical action of the solvent employed. P.S.—In making the cupric oxide with ammonia, the oxide of copper requires a thorough washing before dissolving in the ammonia. The presence of any salt of ammonia, even in very small quantities, interferes with its power in dissolving cotton.

(To be continued.)

## ACADEMY OF SCIENCES.

April 17, 1865.

M. E. MARTIN presented a memoir entitled "*An Electrochemical Study of real Simple Bodies, Ponderable and Imponderable, divided into Two Classes by Peculiar Affinities.*" The author has arrived at a new science of electro-chemistry based on the following assumptions, or, as he regards them, proved facts:—1. That the two electricities are not forces, but simple material bodies endowed with chemical properties, by virtue of which they form compounds with simple ponderable bodies. 2. That the two electric fluids of the battery are not produced by any physical action, but by a chemical action of the ponderable bodies which hold them in combination, and which by uniting with each other set the electricities at liberty. 3. That these same electricities collected by conductors, and transmitted in currents, participate directly in the actions they produce, and combine chemically with the elements they disunite. We may give the author's views at length on some other occasion; at present we may quote the decomposition and composition of water as an illustration of his ideas. Negative electricity he distinguishes as *electrile*, and gives it the symbol El; positive electricity is *etherile*, symbol Et. The formula of hydrogen becomes therefore HEl, and that of oxygen OEt. The two electricities arriving at opposite poles attracts in the decomposition each its proper element, and we have



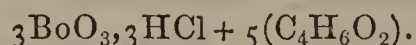
The two electricities in uniting with each other produce caloric, symbol C\*, and light, L\*. Here, then, are the essential principles of electro-chemistry: two electricities possessing peculiar and invariable affinities which unite with each other to form two *imponderable compounds*, heat and light, and with simple ponderable bodies also endowed with peculiar affinities of two kinds. We have thus two classes of bodies:—1. *Oxic*, which includes electrile, an imponderable body, and six ponderable elements, oxygen, fluorine, chlorine, iodine, bromine, and nitrogen; 2. *Basic*, which includes etherile, a simple imponderable body, the basic metalloids, hydrogen, carbon, boron, phosphorus, sulphur, selenium, and silicon, and all the metals. The author concludes—until now chemists have only recognised the effects of chemical union, but have never before discovered the cause—now



the cause is manifest; bodies of the same kind are indifferent to each other, but they unite themselves with all bodies of the opposite kind, and the fundamental law of chemical union thus rests upon the duality of the kinds of simple bodies.

M. Houzeau presented a memoir "*On the Influence of the Seasons on the Properties of Atmospheric Air.*" The author has exposed ozone papers at Rouen for several years, and has found that the chemical activity of the air reaches its maximum in the spring (May and June), diminishes in the summer, and in the autumn almost disappears. It reappears, however, in winter, and becomes specially appreciable in March. The author remarks on the coincidence of this chemical exaltation with the *awakening of nature*, and suggests the study of it to physicians and farmers, who may, he thinks, make discoveries profitable to hygiene and agriculture.

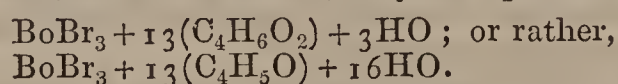
M. Nickles presented a note "*On the Combinations of Boron with the Halogens.*" An alcoholic solution of boracic acid treated with a current of dry chlorine or hydromic acid exchanges oxygen for chlorine or bromine, and forms a chloride or bromide of boron, which remains, however, in combination with organic molecule. A solution of anhydrous boracic acid in absolute alcohol, for example, absorbs hydrochloric acid with avidity; the liquid becomes oily, and fumes in the air. Water decomposes it, reproducing hydrochloric and boracic acids and alcohol. It is not volatile, although the vapours given off contain some chloride of boron. The liquid appears to be merely an alcohol solution of boracic acid saturated with chlorine; and yet, according to the author, it always presents a constant composition, exactly expressed by the formula



When heated, it gives off torrents of boraciferous hydrochloric acid; the thermometer rises rapidly and stops at 85°. The residue is boracic acid. The volatile part is hydrated chloro-boracic ether, having the formula



Hydrobromic acid gives almost similar results. Alcohol saturated with boracic and hydrobromic acids yields a distillate which, rectified at 115°, may be represented as



The above compounds resemble each other in having a corrosive biting taste, in evolving white fumes which deposit boracic acid on surrounding objects, and which colour some woods and turmeric paper brown. From them by distillation with alcohol, the boracic ethers obtained by Ebelmen and Bouquet with alcohol and chloride of boron, may be procured, and thus the necessity of preparing chloride of boron is avoided. The new compounds behave with peroxides like ether charged with hydrochloric acid—that is, they change the peroxides into perchlorides, but the author argues against the ethers containing an hydracid.

M. Reboul presented a note on a "*New Carbide of Hydrogen derived from Amylene by the Subtraction of H<sub>4</sub>.*" When crude bromide of valerylene (a mixture of di- and tetra-bromide) is distilled there passes at 45° to 50° a small quantity of a light mobile liquid, the new hydrocarbide *valylene* C<sub>10</sub>H<sub>6</sub>. It has at once the odour of garlic and prussic acid, and is hexatomic. When treated with ammoniacal cuprous chloride it forms a deep yellow compound C<sub>10</sub>H<sub>5</sub>Cu<sub>2</sub>, which decomposes with some violence when heated, leaving a carbonaceous residue.

#### Evening Instruction in Practical Chemistry.—

We may again call attention to the Birkbeck Course at University College, which commences on May 2. It is open to all engaged in manufactures at a reduced fee.

## NOTICES OF BOOKS.

*Practical Chemistry.* By STEVENSON MACADAM, Ph.D., F.R.S.E., F.C.S., &c. London and Edinburgh: W. and R. Chambers. 1865.

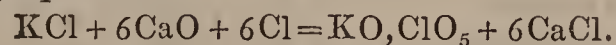
"THIS treatise," says the preface, "is intended for the use of students in medicine and arts, and of advanced pupils in educational institutions. It is arranged in as simple a manner as possible, and the tests and processes given in the work are restricted to those substances which are to be met with in every-day life. The treatise may be regarded as introductory to the larger works on the same subject, and in the hands of an intelligent teacher will serve as a guide to the conduction of classes in practical chemistry."

We need only express our opinion that the book will prove very useful as an introductory work, and strongly recommend it to pupils and teachers.

*Chemical Technology; or Chemistry in its Applications to the Arts and Manufactures.* By THOMAS RICHARDSON, M.A., Ph.D., &c., and HENRY WATTS, B.A., F.C.S. Second Edition. Vol. I. Part 4. London: Baillière. 1865.

#### [THIRD NOTICE.]

THE previous articles have given our readers some idea of the various contents of this useful volume, but a number of very important manufactures described therein still remain to be noticed. The first we come to is chlorate of potash, but about this salt there is little to be said. We need only quote one process,—the best, and that most usually employed. It consists in passing excess of chlorine into a mixture of caustic lime and solution of chloride of potassium contained in close leaden tanks. The reaction which takes place in the operation is represented by the following equation:—



At the end of the operation the solution obtained is filtered, evaporated nearly to dryness, the mass redissolved in hot water, and set aside for the chlorate of potash to crystallise. The chloride of calcium of course remains in the mother liquor, and is usually precipitated by carbonate of soda to yield the *creta precipitata*, so extensively used by pharmacutists and cosmetic makers.

The uses of chlorate of potash are now very numerous, but the most important is in the manufacture of lucifer matches, to which we shall refer presently. Besides this, the salt is largely consumed in compositions for coloured fires, some receipts for which mixtures are here given; that for crimson light is as follows:—

Dried nitrate of strontia . . .	40
„ Chlorate of potash . . .	6
„ Fine charcoal . . .	2
„ Sulphur . . .	13

The sulphur is here directed to be wetted before admixture, but it is better to make the mixture by sifting the ingredients together. It should have been said, also, that red fire made with strontia is, for some unknown reason, liable to spontaneous ignition, and therefore ought only to be made as required.

Incidentally, it is said that chlorate of baryta, which is used for green fire, is formed by passing chlorine into a thick milk of carbonate of baryta at a temperature of 200° or so, whereby the whole mass is changed into chlorate of baryta and chloride of barium.

The history of few manufactures is more interesting than that of phosphorus and its applications. That body, looked upon not much more than a quarter of a century ago as a dangerous chemical curiosity, is now a necessity in every household. Sold not many years ago at four guineas a pound, its price has fallen to as many shillings;



and whereas England once imported nearly all the phosphorus consumed here, we now supply the greater part of the world with it.

Phosphorus is procured by one of the simplest of chemical processes, the reduction of phosphoric acid by carbon. The phosphoric acid is of course obtained by treating bone ash with sulphuric acid. After concentration to a syrupy state it is mixed with wood charcoal, and the mixture is dried and powdered. It is then distilled in clay retorts, the necks of which dip under water. The crude product is afterwards purified by re-distillation. The different stages of this process are excellently described in the book under notice, in which also drawings of the apparatus and arrangements are given. The manufacture of amorphous phosphorus also receives its share of notice, and the account of the process is illustrated by drawings from Mr. Albright's specification.

A long and useful account of the manufacture of lucifer matches naturally follows, of which we need only say that the reader will find all the information necessary for him to set up the trade if he should feel inclined.

We pass to another use of phosphorus in phosphatic manures, of which the authors give a very good account, after a brief notice of phosphates in general. We must refer the reader to the work itself for a number of useful analyses of phosphatic minerals, and we may remark in passing that on this and other subjects the authors have shown a commendable industry in collecting analyses from many sources. These are often of great assistance to chemists, and serve to some extent as guides to the merchant and manufacturer.

We need not detain our readers over the manufacture of superphosphate, but will quote for their information some analyses of samples, the first two of which are reported as of inferior, and the last two as of excellent quality:—

	I.	II.	III.	IV.
Water . . . . .	14.40	13.79	10.80	0.91
Organic matter . . .	8.91	15.00	4.21	—
Soluble phosphate . .	3.60	2.84	20.28	25.70
Bone earth rendered soluble by acids. }	(5.61)	(4.43)	(31.63)	(40.11)
Insoluble phosphate .	6.83	25.54	4.11	6.68
Sulphate of lime . . .	44.23	26.33	46.63	55.43
Alkaline salts (mostly common salts) }	2.52	4.36	10.78	7.96
Insoluble siliceous residue }	19.51	12.14	3.19	2.32
	100.00	100.00	100.00	100.00
Percentage of nitro- gen equal to }	1.44	2.43	0.34	—
Ammonia . . . . .	1.75	2.91	0.41	—

For the estimation of phosphoric acid in coprolites, bone ash and manures, the authors give the following process, which they say is both expeditious and accurate:—

“The substance is dissolved in as small a quantity of hydrochloric acid as possible, excess of ammonia is then added, the precipitate redissolved in acetic acid, and some acetate of ammonia added to the solution.

“A solution of acetate of uranium, made by dissolving ammonio-carbonate of uranium in acetic acid, is finally added, and the solution boiled.

“A greenish-yellow slimy precipitate falls, which contains the whole of the phosphoric acid. It requires, from its character, the following treatment:—Set aside the hot solution on a sand heat, and allow it to settle completely; decant, add more water, boil, and so forth, until the precipitate has assumed a crystalline appearance, when it may be cast on a filter, without fear of choking the pores, and well washed.

“The precipitate is dried and ignited, when the ammonia is expelled, and lemon-coloured phosphate of sesquioxide

$2\text{U}_2\text{O}_3, \text{PO}_5$  remains. This precipitate is allowed to cool, moistened with nitric acid, re-ignited, and weighed.”

We have before alluded to the practice of requiring a chemist to give a valuation of a manure from his analysis. The practice is an eminently absurd one, but if it be continued, it would be well if chemists would agree to uniform data. We find in this work the data per ton in pounds sterling adopted by several chemists for superphosphates, and quote them more for the amusement than the instruction of our readers.

	Ander- son.	Nesbit.	Way.	Hodges.	“North British Agricul- turst.”	Voelcker.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Ammonia . . . . .	60 0 0	60 0 0	50 0 0	50 0 0	56 0 0	60 0 0
Insoluble phos- phates . . . . .	7 0 0	8 0 0	7 0 0	7 0 0	7 0 0	10 0 0
Soluble phos- phates . . . . .	30 0 0	24 0 0	32 0 0	25 0 0	23 0 0	30 0 0
Biphosphate of lime . . . . .	46 16 0	—	—	—	—	—
Alkaline salts . .	1 0 0	1 0 0	1 0 0	1 0 0	Nil	1 5 0
Organic matter . .	0 10 0	1 0 0	1 0 0	0 10 0	Nil	0 10 0
Sulphate of lime .	1 0 0	1 0 0	Nil	Nil	Nil	1 5 0

Now, if a manure maker should adopt Dr. Voelcker's standards, and a farmer consult Mr. Hodges, there would be occasion for a pretty dispute.

The following remarks on this subject deserve the attention of both chemists and manufacturers:—“The difference in the data adopted by chemists can only be explained by the fact that, being neither merchants nor manufacturers, they have, to a certain extent, founded their data upon theoretical assumptions. Some makers use common salt; others employ sulphate of soda; and yet some of the chemists lump them all under alkaline salts at 1*l.* per ton, while one party considers them of no value at all. Again, the cheapest drier a manufacturer can use is sawdust, which cannot be purchased under 1*l.* per ton; and yet it is generally stated to be worth only 10*s.* Lastly, no allowance is made by any party for the expenses of mixing, bags, &c., &c. We believe that the manufacturers have many just grounds of complaint as to the arbitrary way in which their produce is now valued, and it would be to their advantage to combine together to introduce a more correct system into their trade.”

As far as concerns chemists, we believe it would be well for them to confine themselves to stating the results of their analyses, and leave the manure maker and the farmer to settle the price of the article.

## NOTICES OF PATENTS.

1686. *Improvements in the Smelting or Reducing of Lead Ores, and in the Refining and Softening of Lead.* J. H. JOHNSON, Lincoln's Inn Fields, London. A communication. Dated July 7, 1864.

For assisting the reduction of lead from galena and other ores of that metal it is proposed to use scraps of tin plate, by which means a superior quality of metal is said to be produced at less cost. The second part of the invention refers to a process of purification, whereby it is intended to remove the copper, antimony, and other metals from hard lead by throwing sulphur or metallic sulphurets into the reverberatory furnace in which such metal is already melted.

1688. *Cleansing or Clarifying Impure Water.* W. E. NEWTON, Chancery Lane, London. A communication. Dated July 7, 1864.

THE agent to be used for this purpose is an aqueous solution of persulphate of iron, made as neutral as possible, which is to be added to the impure water in such propor-



tion that the ferric oxide thereby precipitated may carry down with it all the suspended and part of the dissolved impurities.

This proposition is very similar to that patented many years ago by Dr. Medlock, who employed metallic iron, which by rusting under water furnished the necessary hydrated peroxide.

1669. *Manufacture of Aniline Colours.* G. PHILLIPS, Holborn Hill, London. Dated July 5, 1864. (Not proceeded with.)

IN the production of lilac and purple dyes from aniline or its homologues the inventor heats these bases with arsenic acid and protosulphate of iron. It is recommended to mix 200 parts by weight of arsenic acid with half that amount of aniline, and to add a like proportion of crystallised sulphate of iron. These ingredients are first dissolved in water, and the solution is boiled down with the aniline until the whole or nearly the whole of the water has been evaporated. The residual mass is then exposed to the temperature of 350° or 400° Fahr. for a period of about four hours, and the colouring matters may then be extracted by digesting with alcohol or methylated spirit, and purified, if necessary, by any of the methods commonly known and employed.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

712. R. A. Brooman, Fleet Street, London, "Improved process for the production of photographic images capable of being inked with fatty inks." A communication from C. M. T. du Motay and C. R. Maréchal, Metz, France.—Petition recorded March 14, 1865.

892. S. Childs, Malcolm Villa, Putney, "An improved method of treating fatty matters."—March 29, 1865.

899. W. Brookes, Chancery Lane, "A new or improved mode of rapidly reducing, cementing, and melting iron and other ores, also iron slag or cinders, dross, and scales or crust, to produce directly therefrom steel or malleable or cast-iron."—A communication from J. B. Helson, Hautmont, France.—March 30, 1865.

957. J. Player, Norton, Stockton-on-Tees, "Improvements in the manufacture of balls, blooms, or slabs of malleable iron or steel."—April 4, 1865.

804. A. Paraf, Glasgow, N.B., "Improvements in dyeing and printing cotton or linen fabrics or yarns."—March 22, 1865.

864. F. Le Roy, St. Saulve, France, "Certain improvements in non-conducting compositions for preventing the radiation or transmission of heat or cold."—March 27, 1865.

900. A. A. Croll, Coleman Street, London, "Improvements in the manufacture of sulphate of alumina."—March 30, 1865.

945. J. R. Wigham, Monkstown, Dublin, "Improvements in the means and apparatus employed for illuminating lighthouses."—April 4, 1865.

966. W. Teall, L. Lepaige, and E. T. Simpson, Wakefield, Yorkshire, "Improvements in the manufacture of lubricating oil and grease." A communication from E. Lepaule, Paris.

970. E. Ritherdon, Fenchurch Street, London, "Improvements in protecting iron ships and other submerged structures from oxidation and corrosion."—April 5, 1865.

979. M. Diosy, Fenchurch Street, London, "A new or improved material to be used in combination with or as a substitute for coffee." A communication from R. C. J. Prevet and M. L. J. Chollet, Paris.—April 6, 1865.

1011. A. G. Hunter, Rockliffe Hall, near Flint, "Improvements in the manufacture of soda and potash."—April 8, 1865.

#### NOTICES TO PROCEED.

3020. J. G. Winter, Chester, "Improvements in revolving retorts, and in the mode of applying heat to the same, designed for producing oil from coals, shales, cannel, and other substances, or for distilling oils."—Petition recorded Dec. 5, 1864.

3080. F. G. Mulholland, Essex Street, Strand, "Improvements in purifying resin or other substances of a similar kind and character."—Dec. 13, 1864.

3095. J. B. Thompson, Rothwell Street, Regent's Park Road, "Improvements in coating iron and steel with silver, gold, platinum, or palladium, and in ornamenting articles with such metals."

3101. P. F. Lunde, Jewry Street, Aldgate, "Improved apparatus for obtaining extracts from vegetable substances."—Dec. 14, 1864.

3147. H. F. McKillop, Belvedere, Kent, "Improvements in compositions for coating or covering ships."—Dec. 19, 1864.

3222. J. R. Breckon, Darlington, and R. Dixon, Crook, Durham, "Improvements in the construction of coke ovens."—Dec. 28, 1864.

306. J. R. Webb, Hibernia Chambers, London Bridge, "A new or improved method or process and apparatus for obtaining the concentrated extract of hops, and for preserving the same from deterioration."—A communication from G. Percy, W. Wells, C. Brown, J. Mulford, and J. M. Webb, New York, U.S.A.—Feb. 13, 1865.

574. C. J. Falkman, St. Petersburg, "Improvements in apparatus for distilling, purifying, and storing spirituous liquors."—March 1, 1865.

591. C. Rahn, Brook Street, Grosvenor Square, "An improved instrument for concentrating light, applicable to dental, surgical, and other operations."—March 2, 1865.

617. A. Akeroyd, Bradford, Yorkshire, "An improved process and apparatus for dyeing and preparing cotton, worsted, and silk warps."—March 4, 1865.

861. C. J. L. Leffler, Broad Street Buildings, London, "Improvements in casting ingots of steel and malleable iron."—March 27, 1865.

880. E. Savage, West Meriden, Conn. U.S.A., "Improvements in hardening and tempering steel."—March 28, 1865.

#### CORRESPONDENCE.

##### *Continental Science.*

PARIS, April 25.

I HAVE no wish to be an alarmist, but it is my duty to inform you that the Academy of Sciences has received intelligence of the outbreak of a new epidemic. Coming as the news does before the Russian plague or fever, or whatever it is, has been disposed of, the information is not cheering; but there is this comfort, that, so far as I know at present, the epidemic I am about to mention is not migratory. It has broken out in Savoy, where happily it remains. There, it seems, it attacks preferentially the inhabitants of the mountains—the poorest people; but it does not altogether spare the richer folk in reputedly healthy districts. Those who lead sedentary and indoor lives are first attacked; outdoor work seems to save people. It is not contagious. I should have said that the disease is not altogether new. There has been an outbreak every winter—since when, do you think? Since the introduction of iron stoves into Savoy! Where these are not in use the disease remains unknown, and just as they are few or many in a neighbourhood the number of attacks rises and falls. Out of 2600 patients seized, not one has been discovered who had not been recently within the influence of an iron stove. I am sorry to say that we have not at present any account of the symptoms of the malady, of which we shall no doubt hear more. Some people are disposed to attribute it to the formation of car-



bonic oxide, which MM. Regnault and Chevreul will not believe is formed under the circumstances. The former gentleman ascribes the disease to the neglect of ventilation, explaining that animal exhalations and miasmata become incompletely decomposed in contact with the hot sides of a stove, and give rise to volatile or gaseous products, which remain in the room, and exercise a pernicious influence on the health of the inhabitants. M. Faye recommends an immediate investigation of the matter by the Commission on Unhealthy Trades; so the doubts about the origin of the disease will be cleared up soon.

A M. Pelon has invented a new heating apparatus adapted to the warming of railway carriages. He calls it a heat-generator. It consists of a cone of wood, which is covered with hemp, and which is made to revolve with great speed within a hollow cone of copper. These are enclosed in a metallic vessel, through which air is passed, and becoming heated in the passage, is then conveyed to the carriage. The inventor proposes to place a generator outside each carriage; motion will be given to the wooden cone by one of the axles of the carriage, and the heated air will be admitted to the vehicle by an arrangement under the control of the passengers. M. Pelon, like every sanguine inventor, thinks his machine capable of very extensive application, asserting that large mills could be more cheaply warmed by his apparatus than by fires. In the meantime, and pending more extended trials, he exhibits a little machine which keeps chocolate hot.

### MISCELLANEOUS.

**Chemical Society.**—The next meeting of this Society will be held on Thursday evening next, at eight o'clock, when the following paper will be read:—"On Phosphite of Magnesium," by Mr. T. P. Blunt.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Monday, May 1, at 2 o'clock, annual meeting. Tuesday, May 2, at 4 o'clock, Professor Frankland, "On Organic Chemistry." Thursday, May 4, at 4 o'clock, Professor Frankland, "On Organic Chemistry." Friday, May 5, at 8 o'clock, Professor Henry Fawcett, M.A., "On Wealth and those who produce it." Saturday, May 6, at 4 o'clock, Professor Bain, "On the Physical Accompaniments of Mind."

**The Actonian Prize.**—We are informed that the sum allotted to Mr. G. Warrington was 100*l.*, not 200*l.*, as stated in our last number but one. No second prize was adjudged.

**Fire Damp in Collieries.**—Mr. G. F. Ansell, of the Royal Mint, proposes a novel application of Professor Graham's law of gas diffusion for the purpose of ascertaining and giving warning of the presence of accumulations of fire damp in coal mines. The apparatus is susceptible of modification, but always consists of two parts, one being an air receptacle, made either of thin india-rubber in the form of a ball, or of glass with a permeable diaphragm of graphite, plaster of Paris, or porous earthenware. The remaining part of the apparatus is purely mechanical, and is intended to serve as an alarum, being either a simple lever with bell attached, or an electric signal communicating with the manager's office. The form of apparatus particularly described by Mr. Ansell is that of a glass U tube, having one aperture closed with a plate of graphite or equivalent porous diaphragm, and a few inches of mercury in the bend. If such an arrangement, filled in the first instance with air, be placed under the influence of an atmosphere containing five per cent., or even less, of light carburetted hydrogen or marsh gas, the presence of such admixture will be instantly detected by the passage of the gas through the interstices of the graphite, and the consequent expansion in volume of the gaseous contents of the tube; the column of mercury then

rises in the opposite limb of the apparatus, and is made to record itself either by completing the circuit of a voltaic alarum, by deflecting a galvanometer needle, or, lastly, by an adaptation of the simpler mechanism of a wheel barometer. We understand that the invention has been patented by Mr. Ansell, and, inasmuch as it gives great promise of successful employment, the apparatus must be deemed well worthy of immediate trial.

**Useful Plants.**—According to a German author, the number of useful plants has risen to about 12,000, but it must be remembered that these researches have been completed only in certain parts of the earth. There are no less than 2500 known economic plants, among which are reckoned 1100 edible fruits, berries, and seeds; 50 cereals; 40 uncultivated edible graminaceous seeds; 23 of other families; 260 comestible rhizomes, roots, and tubers; 37 onions; 420 vegetables and salads; 40 palms; 32 varieties of arrowroot; 31 sugars; 40 saleps. Vinous drinks are obtained from 200 plants; aromatics, from 266. There are 50 substitutes for coffee; 129 for tea. Tannin is present in 140 plants; caoutchouc, in 96; gutta-percha, in 7; resin and balsamic gums, in 389; wax, in 10; grease and essential oils, in 330. 88 plants contain potash, soda, and iodine; 650 contain dyes; 47, soap; 250, fibres which serve for weaving; 44, for paper making; 48 give materials for roofing; 100 are employed for hurdles and copes. In building, 740 are used; and there are 615 known poisonous plants. According to Endlicher, out of the 278 known natural families, 18 only seem up to the present time to be perfectly useless.—*Cosmos*. i. 283.

**Oyster Liquor.**—The liquor of oysters is not simply sea water, than which it contains less salt and more organic matter. When shaken with ether, it deposits some albuminous matter containing 8.75 per cent. of nitrogen. The liquor probably plays some part in the nourishment of the oyster, the weight of which is always nearly equal to that of the liquor. The following is the composition of the liquor:—

Water	. . . . .	95.888
Salts	. . . . .	3.022
Nitrogenised matters	. . . . .	0.560
Non-nitrogenised matters	. . . . .	0.529

Subjoined are the relative weights of shells, flesh, and liquor in a dozen oysters weighing 1482 grammes:—

Shells	. . . . .	1.209
Flesh	. . . . .	1.12
Liquor	. . . . .	1.02

By converting the nitrogen of the oyster into nutritive matter, M. Payen calculates that a dozen oysters represents in nitrogenised matter only the tenth of a man's ration.

### ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the Editor and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11*s.* 6*d.*, by post, 12*s.* 6*d.*, handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1*s.* 6*d.* Subscribers may have their copies bound for 2*s.* 6*d.* if sent to our Office, or, if accompanied by a cloth case, for 1*s.* Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

*Dr. Lyon Playfair.*—Received with thanks.

*J. J.*—The phenomena noticed have received much more simple and satisfactory explanations.

*B.*—You will find the paper in our seventh volume.

*Constant Subscriber.*—Consult Ure's "Dictionary of Arts and Manufactures," or Watts and Richardson's "Technology." There are no separate works on the subjects of repute.

*Book Received.*—"The Simplicity of the Creation," by W. Adolph.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Researches on Yttria,\* by M. O. POPP.*

THE object of the author's researches was to find a process for separating yttria from terbia and erbia. From the results of his experiments he concludes that the two latter bases have no existence.

By employing the different methods indicated by Mosander—namely, the fractional precipitation of solutions of yttria by ammonia, the fractional treatment of oxalate of yttria by acids, the partial precipitation of an acid solution of yttria by oxalate of potash, he always obtained oxides of which the first portions were of a dark yellow colour after calcination, and the rest of a lighter tint. The first represent the erbia, and the second the terbia of Mosander. The latter portions, pure yttria, according to Mosander, always containing alkalies, lime, and basic salts, should be purified by precipitation with ammonia free from carbonic acid. In its pure state yttria is never white, but has a slightly yellowish tinge, and its sulphate is not efflorescent. As for terbia, it is by fresh fractional precipitations easily divided into the most coloured portion erbia, and the least coloured portion yttria.

Berlin† has, moreover, arrived at the same conclusion, and terbium must consequently be expunged from the list of simple bodies.

The comparative study of erbia and oxides of cerium has shown that erbia is confounded with these oxides.

It furnished the yellow precipitate of ceroso-ceric oxide when its solutions were treated by potash and chlorine, and with the spectroscope it also gave the lines characteristic of didymium.

The imperfection of the method of separation by sulphate of potash accounts for the presence of oxides of cerium in yttria. Double sulphates of cerium and didymium are not perfectly insoluble, the degree of solubility depending on circumstances of temperature, concentration, &c.

The author believes he has found a better method of purifying yttria by first transforming oxide of cerium into sesquioxide, then treating the solution by carbonate of baryta, which does not precipitate yttria, but only the peroxides of cerium and didymium.

Yttria thus separated and newly precipitated constitutes a mass resembling hydrate of alumina; it is pure white, and its taking a rose tint when dried proves that it contains cerium. When calcined it has a yellowish-white tinge. The hydrate contains nearly  $YO_2HO$ .

Yttria is an energetic base which expels ammonia from ammoniacal salts on boiling; its properties much resemble those of magnesia.

Hydrated salts of yttria have all a decided rose colour. Solutions of yttria, placed between the prism of the spectroscope and a bright gas flame, give five black lines quite different from those of didymium. Of these rays one is situated in the extreme violet, and one in the extreme red.

The author determined the atomic weight of yttria by the sulphate, which is separated on boiling the solution of sulphate of yttria. This sulphate was precipitated by oxalic acid, the free acid neutralised by ammonia, and finally the oxalate was calcined. Four determinations having varied from 42.04 to 42.008, the mean for yttria

was the equivalent 42.015, or in round numbers 42; for yttrium say 54, admitting the formula YO for yttria.

**Yttrium.**—This metal is obtained by treating the double chloride of ammonium and yttrium. It forms a black powder, becoming lighter by drying, and oxidising slightly in the air. When dry it ceases to oxidise. Water acts on it very slowly when cold, and more rapidly when hot, transforming it into oxide. Diluted acids dissolve it readily with disengagement of hydrogen. When cold, caustic potash does not attack it, and it does so with difficulty when hot.

On platinum foil it burns brightly.

**Sulphide of Yttrium.**—The sulphide cannot be obtained in a state approaching purity except by passing a current of dry hydrogen and sulphide of carbon over yttria heated to redness; even then it contains a little carbonate.

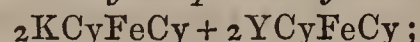
It is of a yellowish-green colour, insoluble in water, but by contact with it is partially transformed into hydrate of yttria and sulphuretted hydrogen.

**Chloride of Yttrium**, dried in a water bath, and crystallised in alcohol, contains  $YCl + 6HO$ . It is deliquescent. The anhydrous chloride cannot be obtained by evaporating the hydrated salt, nor by calcining yttria in a current of chlorine or hydrochloric acid; in each case an oxychloride,  $2YOYCl$ , insoluble in water, is always obtained.

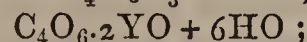
This anhydrous chloride is obtained by calcining the oxide, mixed with carbon, in a current of chlorine, or by heating the double chloride of ammonium and yttrium until the whole of the ammoniacal salt is volatilised. Chloride of yttrium forms a translucent, very deliquescent, crystallised mass. It is not volatile. It combines with bichloride of mercury, forming the crystallised salt  $YCl + 2HgCl + 6HO$ , soluble in alcohol.

The iodide is obtained in a crystallised state by dissolving yttria in hydriodic acid, and evaporating over sulphuric acid. It is deliquescent and soluble in alcohol.

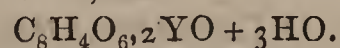
The author besides describes the *fluoride*, the *fluosilicate*, *ferrocyanide* an *yttriopotassic ferrocyanide*,



the *sulphate*  $2(YOSO_3) + 5HO$ , which is precipitated in the form of a crystalline powder when its solution is heated; a *sulphate* of yttria and *potash*; the *seleniate*, which is very soluble at all temperatures; the *nitrate*,  $YO.NO_5 + 3HO$ ; the *carbonate*,  $YO.CO_2 + 3HO$ ; the *phosphate*,  $3YO.PO_5 + 5HO$ ; the *arseniate*, *chromate*, *chlorate*, *acetate*,  $YO.C_4H_3O_3 + 2HO$ ; the *oxalate*,



the *yttriopotassic oxalate*,  $C_4O_6KO.YO + 6HO$ ; two *citrates*, one tribasic with 7HO or 14HO, the other bibasic, with 8HO; *tartrates*,  $C_8H_4O_{10}.2YO + 8HO$  and  $C_8H_5O_{11}.YO$ ; the *butyrate*, which is crystallisable and contains 2HO, and finally *succinate*, which forms a crystalline powder, insoluble in hydrochlorate of ammonia, soluble in diluted acids, its formula being



*The Estimation of Alumina by Carminic Acid, and the Action of some Reagents on Carminates,\* by M. C. LUCKOW.*

A SOLUTION of cochineal or carminic acid has the property of colouring carmine a liquid containing alumina; when acidulated this liquid turns orange. The author has taken advantage of this reaction to make some analytical researches on alumina. The following are the

\* *Annalen der Chemie und Pharmacie*, cxxxi, 179.

† *Förhandlingar med de Skandinavisk Naturforskernes attendo Møde i Kjøbenhavn*. 1860.



results he has obtained. Carbonate of soda precipitates alumina imperfectly; in the presence of an ammoniacal salt the precipitation is more complete; with bicarbonate of soda instead of soda it is almost perfect. The more slowly the cold precipitation by carbonate of ammonia is effected, the more complete it is. The precipitate obtained with bicarbonate is less bulky than that obtained with neutral carbonates, and is consequently more easily washed.

The precipitation of alumina by carbonate of ammonia or ammonia is complete if the liquid is boiled until it returns to its neutral state. The filtered liquid does not give, with carminic acid the reaction characteristic of alumina.

The cold precipitation by ammonia or by sulphide of ammonium is more complete the longer the time taken to effect it, and the smaller the excess of ammonia and the greater the excess of sulphide the better.

By passing a current of carbonic acid into a solution of alkaline alumina, the precipitation of this base is almost perfect.

By boiling an alkaline solution of alumina with chloride of ammonium until the reaction is no longer alkaline, the alumina is completely precipitated.

Alkaline carminates are soluble in water, very little so in alcohol; their solution is of a red violet colour. Alkaline earthy carminates are almost insoluble, the colour of their solution is carmine red.

Carminates are decomposed by acids, giving an orange coloured solution, which does not alter on boiling. The solution of carminate of alumina, such as is obtained by the addition of tincture of cochineal to a neutral solution of alumina, free from iron, has a beautiful carmine colour, which turns to violet by contact with the air, especially when hot; if the solution be acid, this change does not take place; when the free acid is tartaric or citric acid, a red pulverulent deposit, formed probably of carminate of alumina, is, after a short time, obtained; this deposit is very little soluble in water, insoluble in alcohol, but soluble in acids and in alkalies.

Carminates of iron form precipitates of a dark violet (ferrous salts), or brown (ferric salts), slightly soluble in water; strong acids, and also concentrated alkalies decompose them.

Carminates of zinc, nickel, cobalt, and manganese are almost insoluble; their colour is carmine violet.

Salts of lead and copper are insoluble, and dark violet in colour.

By adding a solution of cochineal to a stannous salt, a violet colour is obtained, becoming dark carmine if the solution is shaken in the air, or, better still, with chlorine water.

Carminate of silver is unstable.

## PROCEEDINGS OF SOCIETIES.

### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

April 4th, 1865.

(Continued from page 200.)

Mr. DANCER also read a paper "*On Pseudoscopic Vision through Prisms.*" If we look with both eyes at an object, such as the flat top of a table, for example, and then interpose a prism between one eye and the object, we discover, after a short time, that the portion of the surface to which the sight is particularly directed has apparently changed its distance. If, in trying the experiment, the thin edge of the prism is turned inwards to the nose, the

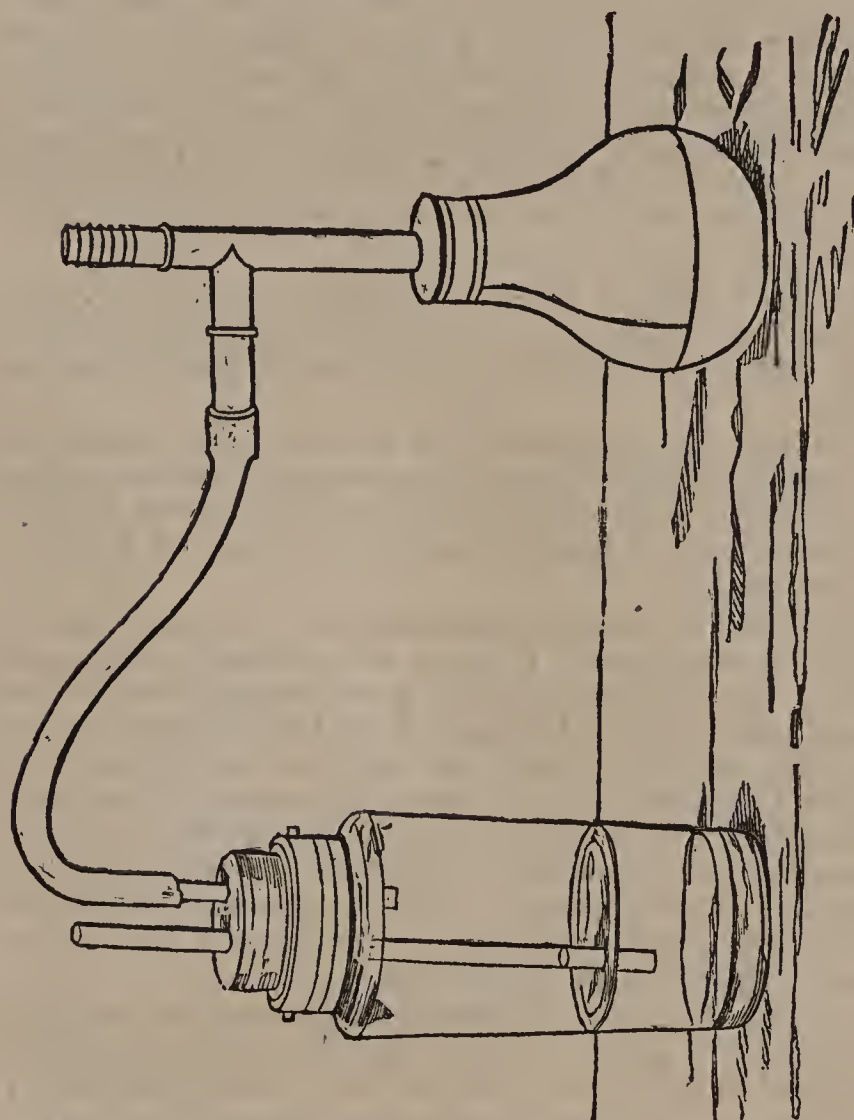
flat surface will appear concave; if, on the contrary, the base or thick edge is turned towards the nose, the surface will appear convex. The full effect of this alteration in the appearance of the object is not realised immediately, some persons see it perfectly in a few seconds, others require some moments of steady gazing before it becomes evident to them. The character of the surface to which the vision is directed exercises some influence in producing the effect. A circular table covered with a cloth of a bright pattern, having a few articles disposed towards the edges, exhibits this fallacious vision in a marked degree. The angle of the prisms for showing these experiments should be about  $15^\circ$ ; if less than this, the elevation or depression of surface is not sufficient to produce a good effect; if the angle is much greater than  $15^\circ$ , many persons are unable to unite the refracted image of the prism with the real image seen by the other eye. Achromatic prisms are much to be preferred in these experiments to those which are uncorrected for colour. Experiments with these prisms have shown that the power of converging the optic axes differs very considerably in individuals. Oculists occasionally recommend prismatic lenses mounted in spectacles to assist persons who suffer from insufficiency of the recti interni muscles; it would be interesting to know if those so assisted have noticed the fallacious appearances which the healthy eye can appreciate. The pseudoscopic effects are exaggerated by using a prism to each eye, but in most persons this produces a painful sensation. The explanation of these phenomena, which I offer with some hesitation, is based upon the supposition that in binocular vision we estimate the distance of an object by the degree of convergence of the optic axes. In these experiments, when a flat surface appears concave by the interposition of the prism: the optic axes are made to converge on a point situated behind the real surface, and the imagination gradually removes the object to this apparent distance. When the base of the prism is towards the nose, then the flat surface becomes convex, in this case the optic axes cross in front of the real surface, and the imagination raises the object to that point. A diagram of the convergence of the optic axes on an object, before and after the interposition of the prism, will show that when the thin edge of the prism is turned towards the nose, the effort made to unite the real and the refracted image is the same as if the vision was directed to a point more distant than the real object. The opposite to this takes place when the base of the prism is turned towards the nose. It is very possible that the pseudoscopic vision through prisms may have been noticed by others, but I have not been able to discover any description of such in the works to which I have access.

Dr. ANGUS SMITH explained a mode of analysis which he has called *Minimetric*. The idea, he said, may perhaps not be quite new, but it is well to give the method a name. It is based mainly on the fact that we can retain in the memory with great exactness the character of a precipitate of a given degree of translucency. For carbonic acid the author finds a precipitate of carbonate of baryta caused in baryta by .2515 cub. c. of carbonic acid, or nearly three times that amount in lime water. If the carbonic acid in air is sought, the air is made to act on the baryta until the precipitate is obtained. If the carbonic acid in air is sought, the air is made to act on the baryta until the precipitate is obtained. In other words, we use the smallest measure of air which will produce the precipitate. For this reason the name minimetric is adopted. The plan may be used for hydrochloric acid, sulphuric and sulphurous acid, sulphuretted hydrogen, &c., and probably has been used frequently without bringing it forward as a method for accurate use. Two modes of using this mode of analysis were described. The first was by the use of a finger pump—an elastic ball with two valves. When pressed the air was driven out, and when expanding the air was drawn through the liquid. The air and liquid were then shaken together. This was repeated until the



precipitate was attained. One easy method of finding the precipitate for comparison was by shaking half an ounce of avoirdupois (14.17 cub. c.) with twenty-three ounces of air in Manchester, or nearly thirty in London or elsewhere, according to residence. Experiments made with this apparatus show it to be extremely delicate. The carbonic acid in the air of a room can be estimated in a few minutes.

A table is made of the following kind, but it must be adapted to the size of the bulb. A cut showing the bottle and finger pump is given.



For very bad air smaller bulbs were shown, such as were recommended for workshops, mines, &c.; a convenient size for common life is here given:—

No. of strokes of the finger pump, or No. of ballfulls of air.	Per cent. of carbonic acid indicated in the air.	Actual amount of carbonic acid in the Air of the ball. Grammes
1	6.0	0.2515
2	3.0	0.1257
3	2.0	0.0838
4	1.5	0.0629
5	1.2	0.0503
6	1.0	0.0419
7	0.8	0.0359
8	0.75	0.0316
9	0.66	0.0279
10	0.56	0.0251
11	0.54	0.0229
12	0.499	0.0209
13	0.460	0.0193
14	0.428	0.0180
15	0.399	0.0167

In all cases only half an ounce of baryta solution was used.

#### Minimetric House and Workshop Method.

Suppose we desire to know if the air contains more than 0.04 per cent. of carbonic acid, we fill a bottle containing 5.422 ounces with air by pumping as elsewhere described, with a little finger pump, and shake in it half an ounce of baryta water. If there is any precipitate at all, the amount

of carbonic acid in the air is above 0.04 per cent. This would indicate that the air is less pure than outside. If we allow 0.06 per cent. of carbonic acid in a room, we take a bottle of the size of  $3.6 + \frac{1}{2}$  ounce = 4.1 ounces, or 116.23 c.c., and if, after a trial as before, we find a precipitate, however small, or a decided, although slight, milkiness, the air is deteriorated beyond 0.06. This relates to dwelling-houses. If for workshops  $\frac{1}{4}$  per cent. (0.25) is allowed, a bottle of 0.867 + 0.5 ounce = 1.367 ounces or 38.744 c.c. is sufficient. This would go into the waistcoat pocket. If 0.5 or  $\frac{1}{2}$  per cent is permitted, a bottle of 0.433 + 0.5 ounce is enough = 0.933 ounces or 26.475 c.c. This amounts to nothing more than shaking an ounce bottle. The addition of half an ounce is for the baryta water. The lime-water method will probably be adopted more usually, as lime is so common. The experiment is exactly the same as with baryta water, but larger bottles are required.

0.06 carbonic acid in the air gives no precipitate or milkiness when  $\frac{1}{2}$  ounce of lime-water is added to a bottle of the air, containing . . . . . 10.9 ounce.

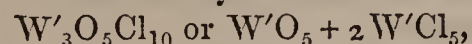
0.25 ditto	ditto	(= 3.09 cub. cent.)
		2.997 ounces.
0.5 ditto	ditto	(= 84.958 cub. c.)
		1.748 ounces.
		(= 49.564 cub. c.)

The author said that by this simple method the greatest refinement could be attained.

#### ACADEMY OF SCIENCES.

April 24, 1865.

M. DEBRAY presented a memoir "*On the Chlorides of Tungsten.*" The primary object of the author's experiments was to determine the vapour densities of these chlorides. To prepare the perchloride he passed a current of dry chlorine over tungsten heated to dull redness, but found that the body obtained in this way is a mixture of perchloride  $WCl_3$ , and subchloride  $W_2Cl_3$ . To procure the perchloride as pure as possible it is necessary to re-distil this mixture in a current of chlorine; but even then an absolutely pure perchloride is not obtained, for it is another example of a body which, like monohydrated sulphuric acid, decomposes at its boiling point, giving a product of a tolerably constant composition under similar conditions, but which cannot be expressed by a simple formula. There are two oxychlorides of tungsten, one red,  $WOCl_2$ , and the other yellowish-white,  $WO_2Cl$ . They are easily obtained by distilling the perchloride with oxalic acid in proper quantities. The author could not determine the vapour densities of the yellow oxychloride because of its ready decomposibility. He determined, however, the densities of the two other chlorides in the vapour of mercury and in the vapour of sulphur, and found them not to agree with either the theoretical density of two or four volumes. He is led, in fact, to the supposition that the red oxychloride has the formula—



which obliges him to admit the existence of bodies whose vapour densities correspond to 12 volumes. The author attempted no explanation of this difficulty, nor did M. Deville, who said a few words on the importance of these experiments.

Dr. Blondlot presented a memoir "*On Black Phosphorus.*" The author shows how phosphorus can be converted into the black variety at will. He distils phosphorus which has been exposed to the sun, and collects it in a flask which is slowly cooled in a water bath; and he finds that it becomes a white mass at about  $44^\circ$ , but at  $5^\circ$  or  $6^\circ$  it suddenly turns to a beautiful black colour. Once obtained this black phosphorus can be re-distilled and fused; it is colourless while liquid, but again becomes black on cooling. The author seems to regard black as the proper colour of phosphorus.

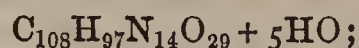


M. Violette presented a note entitled "*Researches on the Cause of the Crystallisation of Supersaturated Solutions*," and M. Gernez a note "*On the Crystallisation of Supersaturated Saline Solutions*," and "*on the Presence of Sulphate of Soda in the Air*." Both of these notes relate to the circumstances attending the crystallisation of a supersaturated solution of sulphate of soda, and the two authors have come to the same conclusion on one important point—namely, that there is but one body capable of bringing about the sudden crystallisation which takes place with such a solution, and that is, a fragment, no matter how minute, of the same salt. The two authors imagine they have discovered a new method of analysis when they have found that to induce crystallisation of supersaturated solution a fragment of the dissolved salt is necessary.

M. Persoz continued his memoir "*On the Molecular Condition of Bodies*;" but this section requires no notice.

Dr. Frankland and M. Duppa communicated some "*Synthetical Researches on Ethers*," which we shall no doubt see in the *Proceedings* of the Royal Society; so pass them here.

MM. Millon and Commaille presented another note "*On the Caseine of Milk and its Affinities*." In a previous note the authors announced that caseine combined with acids in definite proportions; they now show that these acid compounds function as chemical units, like caseine itself. Sulphuric and phosphoric acid the authors state may be united simultaneously with caseine; and they remark that this fact will strike those who know how common it is to find both sulphur and phosphorus in albumenised matters. The compounds of caseine with acetic, hydriodic, perchloric, and hydrosulphocyanic acid are all decomposed by water, and from the acetic compound pure caseine may be separated. The authors have analysed this, and state its composition to be



that is, a double amide of tyrosine and leucine. This, by the way, is soluble caseine; the insoluble has only three equivalents of water.

M. Blondeau presented a note "*On Goëmine*," a neutral body extracted from *Fucus crispus*, or Carrageen moss. The jelly obtained from this seaweed is, of course, not formed of ordinary gelatine, but by a neutral body soluble in hydrochloric and nitric acids, and in potash. Its centesimal analysis is as follows:—

Carbon	.	.	.	.	21.80
Hydrogen	.	.	.	.	4.87
Nitrogen	.	:	.	.	21.36
Sulphur	.	.	.	.	2.51
Oxygen	.	.	.	.	49.46
					100.00

The abundance of nitrogen in the compound shows it to be a valuable nutriment.

## NOTICES OF BOOKS.

*The Applications of Geology to the Arts and Manufactures.* Being Six Lectures on Practical Geology, delivered before the Society of Arts, as a part of the "Cantor" Series of Lectures for 1865. By Professor D. T. ANSTED, M.A., F.R.S., &c., &c. London: Hardwicke. 1865.

WE are bound to praise the mode in which the money bequeathed to the Society of Arts by the late Dr. Cantor has been employed, and more particularly the selection of the lecturers. Although these latter have addressed a too exclusive audience, one of them has, and will shortly again, we hope, find a much more extensive one in our own pages, which will thus convey to thousands

the useful and varied information that was listened to by a few only.

Of these lectures by Professor Ansted, we can speak in very high terms. No one is better qualified than he to speak of what we may call the raw materials of the earth's crust. It is only when dealing with manufacturing processes that the learned Professor goes a little astray,—witness the chapter on Cements and Plasters; but as no one will think of reading his book as a guide to manufactures, we may pass these slight blemishes by as of small account.

The lectures are six in number, and are devoted respectively to agricultural geology, springs and water supply, minerals obtained from superficial deposits, minerals from stratified deposits (two), and minerals obtained from mineral veins and mining. This programme will give our readers the best idea of the contents of the book, and for the rest we need only say that they will be read with as much pleasure as profit.

We have marked several passages for quotation, but have only room for one on the formation of vegetable soil, which will give our readers a good idea of the Professor's style.

"Every kind of vegetable soil was once rock, which, by the unintermitting action of heat and cold, air and water, has been broken down by degrees into smaller and smaller fragments, until at last it is reduced to a kind of powder, dust, or mud.

"The part of this process performed by the atmosphere is called *weathering*. It goes on constantly—day and night, winter and summer; in a wet or dry, in a calm or stormy atmosphere. It breaks down the hardest rocks on the lofty mountain tops, as well as removes the soft mud on the plain. It eats away the bottom of the deep-sheltered valley, and pares away the surface of the barren exposed moor. It affects the toughest granite and the softest clay or loosest sand. Wherever rock is exposed to the air it becomes weathered, and weathering means ultimately a reduction to fine powder.

"On the granite or quartz rock exposed on the cliff or in the quarry a group of small lichens is seen to grow. These only seem to ask from the rock a solid foundation; but they are insidious enemies, as, although they derive their nourishment chiefly from the atmosphere, and might be thought even to protect the exposed naked surface from the weather, they really pave the way for destruction. That which they separate from the air and employ in the construction of their lengthening bodies becomes after their death a brown pulverulent mass, or *humus*, which affords nourishment to larger individuals of the same tribe. At length there is sufficient of this humus or vegetable soil to support a higher class of vegetation. Various mosses succeed the lichens. These take root, and small crevices, such as are formed by exposure on the surface of all rocks, receive their roots. Once inserted, these roots expand and exercise an irresistible force, splitting asunder the rock and breaking up the surface. Other roots are thus enabled to penetrate yet further, and after a time the first mosses are succeeded by more vigorous branching kinds, and these again, according as the climate is dry or moist, are followed by heather, ferns, grasses, or small shrubs, until at length, each generation of plants working its way deeper into the rock and increasing the quantity of soil, there is attained a sufficiently deep thickness of earth to enable forest trees to grow, thrusting down their rootlets to a great depth in the crevices, and making room for the admission of rain. In due time frost comes, rending asunder the rock, and producing in hilly countries or near cliffs frequent slips and slides, falling into the valleys below, but soon spread over the surface and lost sight of, being washed away by the rain."

We have extracted this passage from the lecture on Agricultural Geology, which is particularly good; but the reader will peruse the whole book with equal interest.



*Annales de Chemie et de Physique.* March, 1865.

THIS number of the *Annales* contains the conclusion of M. Gauguain's memoir on the theory of electric condensers, and an interesting historical notice of the mechanical theory of heat, by M. Bohn. An account of some experiments by Payen, "*On the Action of Diastase on Amylaceous Substances*," is of some interest, inasmuch as they disprove some assertions of Musculus (see *CHEMICAL NEWS*, vol. ii., p. 299). The latter gentleman has stated that diastase is without action on dextrine; that diastase in reacting on starch produced dextrine and glucose simultaneously in the proportion of one of glucose and two of dextrine; and hence, in the manufacture of alcohol from grain, there was a waste of two-thirds of the raw material. Payen now proves that diastase can, in part, transform dextrine into glucose; the progress of the action is hindered by the presence of glucose, but is resumed when this glucose is removed; that in the alcoholic fermentation nearly the whole of the amylaceous matter is transformed into alcohol, &c.; that diastase reacting on starch under favourable circumstances converts about half into glucose. These experiments being of some practical importance, we shall give the account of them at length.

A very interesting paper by M. Morren follows "*On the Phosphorescence of Rarefied Gas during the Passage of the Electric Spark*." The author endeavoured to discover the cause of the milky-white fog seen in some of Geissler's tubes. It has been attributed by many to the presence of oxygen; but this idea M. Morren shows is incorrect. He finds, in fact, that pure and dry oxygen, however much rarefied, is never phosphorescent; and indeed that no gas, simple or compound, is phosphorescent by itself. A mixture of oxygen and nitrogen with 37 of nitrogen to 100 of oxygen is feebly phosphorescent; but the phenomenon becomes much more visible when a little vapour of nitric acid is added to the mixture. But it becomes magnificent and lasting when to the preceding mixture a drop of Nordhausen acid or a little vapour of sulphuric acid is added. The same result may be obtained by passing the spark through a rarefied mixture of the following gases:—

Oxygen	.	.	.	.	.	500
Nitrogen	.	.	.	.	.	200
Sulphurous acid	.	.	.	.	.	300

Or,

Very dry atmospheric air	.	.	.	.	.	100
Oxygen	.	.	.	.	.	30

and a little Nordhausen or anhydrous sulphuric acid. Other acids besides sulphuric will produce similar results—nitric and carbonic, for example; and the author shows the probability of being able to combine these gases with  $\text{NO}_3$ . He states that it is possible to form directly the compound  $\text{NO}_3\cdot 2\text{SO}_3$  by the spark in convenient apparatus.

A paper, by the same author, "*On the Flame of Some Carburetted Gases, particularly Acetylene and Cyanogen*," succeeds. We have already noticed this paper (*CHEMICAL NEWS*, vol. ix., p. 135) in connection with the spectrum of carbon, and the theory of the candle flame. The same author gives an account of a *new air-pump*, or rather *mercurial aspirator*, invented by himself, which is said to be extremely convenient for exhausting limited spaces. A description of this machine would be useless without a drawing, so we refer the reader anxious in the matter to this journal, in which a good drawing is given.

The next paper is also by M. Morren—"On the Electric Conductibility of Gases at Low Pressures,"—at the close of which he describes some beautiful phenomena obtained with cyanogen, and mentions the deposition from this gas at the positive electrode of a reddish-brown substance, which is soluble in *aqua regia*, and which solution, on the addition of distilled water, gives a yellow gelatinous precipitate.

The report made to the Academy "*On the Experiments Relative to Spontaneous Generation*," which follows, we

have already noticed, and also the concluding paper—on M. Weil's "*New Process for Coating one Metal with a Brilliant Layer of another Metal*." As, however, the process is more fully described here than in any account of it we have met with before, and as it is of some practical importance, we shall return to it again.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

240. C. D. Bergue, Strand, "Improvements in furnaces."—Petition recorded Jan. 27, 1865.

705. F. Wise, Chandos Chambers, Adelphi, "Improvements in preparing certain colouring matters for dyeing and printing." A communication from J. Levinstein, Berlin, Prussia.—March 13, 1865.

980. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the means of, and apparatus for, increasing the illuminating power of hydrocarbon oils and gases." A communication from T. S. Speakman, Camden, New Jersey, U.S.A.

984. W. B. Richards, New York, U.S.A., "An improved mode of preventing corrosion or staining of the surface of glass."—April 6, 1865.

997. W. Jackson, Glasgow, N.B., "Improvements in the method of mixing gases and vapours, and in the machinery or apparatus connected therewith."—April 7, 1865.

1008. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "An improved composition for preventing the fouling of ships and other vessels." A communication from W. B. Davies, Brooklyn, King's County, New York, U.S.A.—April 8, 1865.

1023. C. Vaughan, Birmingham, "Improvements in the manufacture of iron and steel."

1027. R. A. Brooman, Fleet Street, London, "Improvements in apparatus for storing petroleum and other inflammable liquids of less specific gravity than water." A communication from F. Bizard and P. Labarre, Marseilles, France.—April 11, 1865.

1049. J. S. Bickford, Camborne, Cornwall, "The manufacture of an improved safety fuze."—April 12, 1865.

### NOTICES TO PROCEED.

3071. J. Vaughan, Middlesbro', Yorkshire, "Improvements in the heating the blast for furnaces in the manufacture of iron."—Petition recorded December 10, 1864.

3075. E. Brooke, Huddersfield, Yorkshire, "Improvement in the manufacture of glass house pots."—December 12, 1864.

3082. R. H. Johnson, Ecclestone, Lancashire, "Improvements in the construction of glassmakers' pots and in the application of heat to the materials or glass metal contained therein."—December 13, 1864.

3108. J. A. Pols, Old Kent-road, Surrey, "Improvements in obtaining purified or refined oils, and in obtaining oil cakes for cattle food, and foots for soap-making."—December 15, 1864.

3131. A. A. L. P. Cochrane, Portsmouth, Hampshire, "Improvements in apparatus for heating and evaporating liquids and fluids."—December 17, 1864.

3164. H. A. de Brion, Welbeck Street, Cavendish Square, Middlesex, "An improved varnish for protecting and preserving metals, such as polished steel, silver plate, silver-plated and electro-plated articles from oxydation, corrosion, and from the effects of damp, or the action of sulphuretted hydrogen and improved liquids for cleaning and brightening said articles."—December 21, 1864.

3252. L. P. E. Max, Paris, "Improvements in treating oils and hydrocarbons, and in apparatus for the same, and other operations in which matters have to be purified, clarified, and refrigerated or condensed."—A communica-



tion from E. Laporte, Boulevard de Sebastopol, Paris.—Dec. 30, 1864.

160. M. B. Mason, New York, U.S.A., "An improved method of purifying and oxidising metallic ores."—Jan. 19, 1865.

344. W. Sim, Glasgow, N.B., "An improved method of, and improvements in apparatus for extracting gases from mineral oils, and employing the same for illuminating purposes."—Feb. 7, 1865.

402. L. H. G. Ehrhardt, Richmond Road, Bayswater, "An improved gunpowder."—Feb. 15, 1865.

645. A. C. Henderson, Charing Cross, Middlesex, "An improved method of preserving meat."—A communication from H. F. Méressart, Paris, France.—March 8, 1865.

691. J. Henderson, New York, "Improvements in the process and apparatus for refrigerating or freezing liquids."—March 11, 1865.

## CORRESPONDENCE.

### Continental Science.

PARIS, May 2.

THE delegates from the learned societies of France held their sittings at the Sorbonne last week. Many very interesting papers were read at these meetings, most of which, however, have already been communicated to the Academy, and I see that you have noticed them in your pages. But there were some original communications made, of which I shall hope to furnish you with some account. It is thought, however, that the proceedings were of less interest than usual, and the attendance was smaller.

Some public experiments have recently been made with Galibert's apparatus, which I mentioned some time ago. A fireman, furnished with the apparatus, went into a room filled with sulphurous acid, and remained there twelve minutes without experiencing any discomfort. M. L'Abbe Moigno also exhibited, and made a trial of, the apparatus at his last monthly meeting with full success. It would be well if this invention were introduced to the notice of the London scientific public, as it seems to afford perfect safety in the most vitiated atmosphere.

A method of preserving ice is going the round of the papers here, which I send you, as it is often required to keep some as long as possible when people are not provided with an ice-safe. Put the ice on a dish and cover it with a napkin, then set the dish upon a feather bed or pillow, and place another bed or pillow on the top of it. In this way you may keep a few pounds of ice for a week or more.

I may mention here the existence of a society such as probably some would like to have in London. It is a society of naturalists, who meet every Sunday from May to August, and make short excursions in the environs of Paris to collect botanical, entomological, geological, and palæontological specimens. They made their first excursion last Sunday in the Forest of Montmorency.

Two gentlemen, MM. Sicard and Schoras, have chemically examined some poisonous mushrooms, and have succeeded in extracting an extremely poisonous substance, which appears to have basic chemical properties. The physiological effects seem to resemble those of curarine. I have not yet seen the process by which this poison is isolated.

Your surgical readers will, no doubt, see with much interest an account of an operation by M. Ollier, well known in England by his experiments on the reproduction of bone from the periosteum. That which M. Ollier has often shown to be possible in the case of animals, he has now shown to take place in the human subject. He removed the upper half of the humerus from a child, six years old, for disease of the shoulder-joint, carefully

detaching the periosteum all round, and dividing none of the muscular attachments. The child now, seven months after the operation, is in good health, and the arm is almost perfectly restored.

M. Seguiet, who claims to have first suggested the combined use of gun-cotton and coarse-grained gunpowder, which Mr. Whitworth has latterly adopted, has sent to the Academy an account of a cartridge he has invented, which he considers to have many recommendations. He puts into a metallic case a certain amount of gun-cotton, and on this he places a perforated wad. Upon this wad he puts the coarse-grained powder, and now the projectile, which rests upon the powder. By a peculiar contrivance, something like that of the Prussian needle gun, the powder is first ignited, and then the gun-cotton. The author states that the best application of the force developed by the conversion of solid into gaseous matter is to generate this force *crescendo*, as the musicians say, first overcoming the *inertia* of the projectile, and then giving its greatest velocity. The velocity obtained with these cartridges seems to be prodigious; but one thing will greatly recommend them—there is said to be no recoil of the gun when they are employed. I ought to have told you that the author uses spun, not carded cotton.

## MISCELLANEOUS.

### FAREWELL DINNER TO DR. HOFMANN.

ON the evening of the 28th ult., at the Albion Tavern, Aldersgate Street, a number of gentlemen who have worked with Dr. Hofmann at the Royal College of Chemistry at different periods from its opening in 1845 to the present date, entertained the Professor at a farewell dinner immediately before his departure for Berlin.

The chair was occupied by Dr. Warren De La Rue, F.R.A.S., F.R.S. The following is a list of those who took part in the entertainment:—Their Royal Highnesses the Comte de Paris, the Duc de Chartres, and the Prince de Condé; Messrs. F. A. Abel, F.R.S., A. H. Church, M.A., W. Crookes, F.R.S., G. B. Buckton, F.R.S., F. Field, F.R.S., W. Odling, M.D., F.R.S., E. C. Nicholson, J. Kayess, B. Condry, G. Maule, A. P. Price, Ph.D., W. Valentin, W. H. Perkin, G. de Mussy, M.D., R. M. Hands, H. Müller, Ph.D., M. Holzmann, Ph.D., W. Squire, Ph.D., S. Heywood, M. Garcia, J. S. Brazier, — Böttinger, Ph.D., P. Griess, B. Duppa, H. Basset, W. Scott, — Barret, Ph.D., E. Owen, H. Medlock, Ph.D., T. Bealey, W. T. Dent, J. Spiller, E. O. Brown, R. E. Alison, J. A. Spencer, C. Berger, J. Newlands, E. Southby, W. Wilson, J. Matthews, E. J. Chapman, P. Chabot, M.A., A. Vacher, R. Barton, J. B. Barnes, W. Spiller, B. Cooper, G. F. Ansell, A. Murgatroyd, W. J. Belton, C. O'Sullivan, G. Davis, G. F. Pritchard, W. T. Fewtrell, F. A. Potter, H. T. Lowe, J. Romanes, F. A. Manning, J. Davidson, W. J. Barnes, H. Tomlinson, J. Williams, W. J. Roberts, J. P. Wilson, T. Royle, L. Heseltine, &c.

During the dinner, which was on a magnificent scale, an excellent selection of music, both instrumental and vocal, was performed by the band of the Royal Artillery, under the direction of the talented bandmaster, Mr. Smyth.

After the usual loyal toasts, the CHAIRMAN called upon the honorary secretary, Mr. Field, for his Report.

Mr. FIELD rose and said: In presenting you, Mr. Chairman, with a brief report of the duties which have devolved upon me as Secretary to the "Farewell Dinner to Dr. Hofmann," I have great satisfaction in stating that from all quarters, not merely in our immediate neighbourhood, but from far distant localities—from the most distinguished



chemists of our country to the youngest student just stepping upon the threshold of chemistry—from the lowliest amongst us to the scions of the royal and illustrious house who have honoured us this evening with their presence, there has been a concurrence of sympathy and spontaneity of acquiescence in our proposed arrangements which have rendered the task of secretaryship not only easy, but delightful. I have issued more than two hundred and fifty letters of invitation to gentlemen who have studied under Dr. Hofmann in the College of Chemistry, from its commencement to the present date, a period extending over nearly twenty years. Many students have doubtlessly and unavoidably been omitted, for although it was not difficult to arrive at the names of those gentlemen, it was not so easy to discover their places of abode. Chemists move often in an eccentric orbit, and at times are somewhat erratic in their movements. There are many, at this present moment, in distant parts of the globe, disseminating, let us hope, the light of their knowledge to others less fortunate than themselves. With such, it was impossible to communicate in time, even had it been possible for them to attend. Many also during their stay at the College had merely temporary resting-places in London, and had left no trace behind. But we have been fortunate altogether in our research; and in the reluctant refusals which distance and want of opportunity have rendered imperative, there is a prevailing characteristic throughout of regret and disappointment at the impossibility of meeting us this evening. It would be in vain for me, without trenching too much on your valuable time, to read all the correspondence which has been received, or even to afford you a list of the correspondents. You will allow me, however, to select a few names, more conspicuous, perhaps, than others, that I have noticed in the multifarious communications which I have received. Dr. Rowney would have had the greatest pleasure in attending, had not the distance from London and his occupations in the College at Galway prevented him from doing so. Dr. Rowney, Mr. Chairman, will be well remembered by you and the earlier students as an amiable colleague and genial friend, and by those who are not personally acquainted with him as a most accurate and conscientious analyst. M. Kuhlmann, of Lille, also begged me to acquaint the committee how much his heart was with us, and he insisted on sending his subscription. Dr. Muspratt, of Liverpool, regrets that his departure for the Continent will not allow him the satisfaction of meeting with ourselves his early friend and collaborateur, Dr. Hofmann. Captain Hore especially regrets that his engagements at Paris prevent him joining us to-night. Dr. Geiger and Mr. McLeod, two of Mr. Hofmann's present assistants, have already left for Berlin. Colonel Reynolds, an old and distinguished collegian, is extremely disappointed that a sudden journey to France has deprived him of the delight he should experience in joining us round the festive board. Dr. Galloway writes in the same spirit, wishing for his own sake that our meeting had been in Dublin instead of in London, and I regret to say that I have only this moment received a note from Mr. Sieveking, informing me that domestic indisposition unwillingly keeps him away. And so, Mr. Chairman, might I go on mentioning many more of our old friends, and it almost seems invidious, and it is certainly difficult to select one correspondent from another, when all write the same sentiments and every refusal is tempered with an equal regret. I have three communications to make from among the absentees in our Committee. Mr. George Simpson (one of its earliest members) is compelled to forego the pleasure he had anticipated, as a recent and severe domestic affliction has rendered his presence impossible. Dr. D. S. Price has an important engagement in another part of England, and Mr. Edward Thomas has recently left for France. Among the guests whom the Committee have done themselves the honour to invite, I have to

mention two names especially interesting to us. The Master of the Mint, Mr. Graham, one of the oldest friends of Dr. Hofmann in this country, delayed answering the letter of invitation for some days, trusting that a severe and troublesome cough from which he was suffering would disappear, and allow him to meet us to-night. Such, unhappily, has not been the case, and he had finally to send a definite refusal, concluding his letter with these words:—"Although I shall not be with you, believe me, my whole heart is in the success of the entertainment." The other name, Sir Thomas Clark, is one peculiarly endeared to us, for every Royal Collegian owes a debt of gratitude to that distinguished baronet. Many of us are old enough in our college life to recollect the time immediately after the Institution was established. We may remember that when the enthusiasm of its commencement had passed away, a corresponding reaction set in, that many of its earliest supporters dropped off, while others merely looked calmly and passively on; that dissensions of a painful and personal character, on which it is needless here to dwell, sprung up amongst its very originators, and such was the state of affairs that not only was its ultimate success deemed problematical, but its very existence seemed imperilled, and the outside world began to consider that the establishment of a college for abstract science was merely a vain and chimerical dream. Then, as ever, Sir James Clark stood forth—its devoted and fearless champion. From among the most conflicting elements he slowly and surely restored harmony and order. Encouraging the Professor (then a recent inmate in England) by his counsel and advice; stimulating the students by his frequent interest in their labours; attaining, by his great influence, from the highest quarters a patronage and distinction for the College, he was, as he still is, its firm, consistent, and undeviating friend; and it is pleasant, Mr. Chairman, for us to reflect that he still lives, and that, in the full maturity of his years, he regards, with no spark of the arrogance that sometimes accompanies an ambition accomplished, but with a pride and complacency at which it would be difficult to cavil, the signal triumph of his earnest and zealous labours. I will read his letter:—

"A public dinner to Dr. Hofmann by the gentlemen who have had the advantage of listening to his lectures and instructions since his arrival in England is a grateful act on their part, well merited by the Professor, and one which cannot fail to be gratifying to him. It would have afforded me great pleasure to have been present on the occasion, but the state of my health unfortunately compels me to forego the great gratification of joining your social meeting to do honour to my esteemed friend. Circumstances have thrown me into intimate relations with Dr. Hofmann ever since, and even before, his arrival in this country. I formed a high estimate of his character at a very early period of our acquaintance, and our uninterrupted intercourse ever since has more than confirmed my first impressions. The high scientific position which Dr. Hofmann so justly holds among the chemists of Europe, and the character of the institution over which he presides, and which, it may be fairly said, he created, have not been attained without the exercise of great talents and untiring labour; while his teaching and researches have given an impulse to the progress of chemistry in this country for which it owes him a debt of gratitude. The Doctor's absence from England will, I trust, be only temporary, and that, when the great object for which he has been called to Germany is accomplished, we shall have him again amongst us, contributing anew, by his genius and researches, to the further advancement of the science already so much indebted to him. I must beg you to excuse the length which I find my note has assumed. The truth is, that I could not express my sincere regret at being unable to attend your dinner without expressing the high opinion I entertain of Dr. Hofmann's character and merits."



Such is the letter from Sir James Clark, and with it my report is concluded. Valuable in itself as a document, it is especially valuable to us, as containing those sentiments which you, Mr. Chairman, and all of us so fully, so cordially, and so heartily endorse, and gratifying as it is in every sense, and is doubly so in giving us the assurance that the departure of Dr. Hofmann does not betoken a final separation, but a temporary absence,—that he leaves us, in fact, merely for a season to prosecute in another land a new and a glorious crusade. (Loud cheers.)

The CHAIRMAN, in proposing the toast of the evening, said:—With mingled emotions I rise to propose to you the next toast, for I am deeply impressed with a desire to do justice to my subject; while, at the same time, I am fully aware of my inability worthily to acquit myself of the task. Literally and metaphorically, my heart is in my mouth, for I have to propose for your acceptance the health of one of my oldest and most loved friends on the eve of his departure. For twenty years I have been acquainted with Dr. Hofmann. I have known him under a variety of circumstances, and it is not assuming too much for me to say that I know his innermost heart; and the more intimately I have become acquainted with his motives of action the more highly have I appreciated his great moral worth. (Cheers.) Twenty years!—years that have passed with me almost as a dream; yet how eventful a period in the progress of chemical science. I look back, and try to fix some of the marks by which to measure out and fully appreciate the continuous current of invaluable discovery inaugurated by the advent in England of Dr. Hofmann, and I recall at once the fact of his introducing me at an early period to one to whom he was much attached. Ani-line, then a very coy personage, would throw around herself a purple veil, and disappear when brought into the presence of such energetic personages as chlorine. (Laughter.) *Aniline* is now a matron, with numerous offspring, whose names I do not pretend to recollect, for names with me are slippery things, and some of them are nearly unpronounceable. But I recollect one on whom we have all gazed with admiration—her beauteous daughter *Rose*. (Laughter.) The mention of the family of aniline at once reminds us of a long series of substantial benefits conferred upon England by Dr. Hofmann's teaching; but I must take you back to the earlier years of his stay amongst us. The promoters of the College of Chemistry, in their zeal and confidence in the support of the public, made such offers to Dr. Hofmann that he was induced to accept the professorship. Some of us know that the ability of the promoters to perform their part of the arrangement fell very far short of their anticipations—the existence of the College being, in fact, in danger—and Dr. Hofmann voluntarily gave up in succession, first a portion of his salary, then his share of the students' fees, and lastly his house. Yet during this trying period he never in the slightest degree relaxed his efforts to establish the reputation of the College. (Cheers.) He not only gave up the money which was his due, but, out of his extreme devotion to the educational objects of the College, abandoned what to a German *savant* is of still greater importance, his original scientific investigations. This, I know, he felt at the time most keenly, for not only was he relinquishing a pursuit productive of the highest and purest pleasures, but he was jeopardising his future if the College should unfortunately fail to establish itself. Happily the College has stood fast, and our friend has built up the temple of his fame on so many bases that it cannot fail to endure so long as chemical literature shall exist. (Laughter and cheers.) While speaking of the early trials of the College I must not omit to mention the honoured name of one for whom I have the highest reverence: I allude to Sir James Clark, who stood by our College and our friend in every difficulty. Sir James Clark's efforts in promoting science will hardly ever, perhaps, receive proper recogni-

tion, for his labours have been so unostentatious that scarcely a record of them is left, except in the memory of his friends. Science and men of science have few such staunch friends as Sir James Clark. Dr. Hofmann has been extremely happy in his choice of assistants, and throughout his long and prolific career has been surrounded by such a staff as it has rarely been the lot of any chemist to attract about him. But so, also, has he shown great judgment in selecting other agents—perhaps I ought to say reagents,—(laughter)—and although it would be invidious to select any of his animate friends, when so many are present, yet I may, without danger of wounding the susceptibilities of his inanimate aids, name iodide of ethyl as a substitution agent, which has done much for the progress of organic research. (Cheers.) We are all aware that many inducements were offered to Dr. Hofmann to direct his thoughts to technological chemistry—for a long time, however, without effect, and that when he did almost reluctantly consent to undertake such work, it was usually prosecuted at that period of the day which is generally devoted to recreation or rest. It gives me great pleasure to call to mind, as also it must do in the case of several around me, the many profitable hours spent with our friend in this extraneous work, which usually commenced about midnight, and terminated only when the small hours had grown sensibly larger. Of Dr. Hofmann's teaching it is hardly necessary for me to speak, except to express in his presence the exalted estimation in which it is held by us all. (Cheers.) His deservedly high reputation as a chemist is not greater than his fame as a teacher. We all know that when he speaks the various bodies of which discourses seem no longer inanimate, so vividly does he pourtray their habits and affections, their dislikes and preferences, the causes and characteristics of their mutual actions and relations. Even the crotchets of the atoms are laid bare—(laughter)—and we learn that if it be desired to hold more than a certain number of them in friendly union with some other body, it is needful first of all to induce the co-operation of auxiliary groups. One prominent feature in Dr. Hofmann's teaching has always been the kind and painstaking encouragement he has invariably bestowed on those of his pupils who have desired to enter on original research—(cheers)—and it is gratifying to notice among those met here to-day to say farewell so many who have distinguished themselves in the various branches of chemistry to which they have devoted their attention. You are aware that Dr. Hofmann has, after much persuasion, assented to propositions made to him by the Prussian Government with the view of inducing him to undertake a most important mission. It is most creditable to that Government that they so fully appreciate Dr. Hofmann's high mental, moral, and social qualities, which so peculiarly fit him for the honourable post to which they invite him. It was at one time thought that this would have to be a final leave-taking; but, fortunately, our Government having at the eleventh hour become aware of Dr. Hofmann's intended departure, and being keenly alive to the loss the country would thus sustain, have declined to release him from all the bonds by which he is bound to us, and so we hope in a few years to ask him to meet us again on his return to our land. (Cheers.) It is our fervent wish that in the meantime he may enjoy continued health and ever-increasing prosperity. We should be sorry if this meeting were to pass away just as a passing tribute of our gratitude, and we desire to record in some formal manner that we are here assembled to wish you farewell, and to express a hope that we may see you here again. (Loud applause.)

The memorial (a record of the entertainment on vellum, with the signatures of those who joined in it attached,) was then presented to Dr. Hofmann.

The toast was drunk upstanding and amidst enthusiastic cheers.

*German Song*—"Lebewohl."



Dr. HOFMANN, in responding, said:—Mr. Chairman, Gentlemen,—Allow me to convey my heartfelt thanks to you, Mr. Chairman, for the kind words—kind is an inadequate term—in which you have been pleased to propose my health, and to you, gentlemen, for the cordial manner in which you have received the toast. But, believe me, I do not misinterpret the true sense of these expressions. It is a genuine impulse of the human heart, on occasions like the present, at the moment of parting, to overlook a friend's shortcomings, and to keep only the bright side of his character in view. It is in this spirit that our President has given you a sketch of my English career. There would be no difficulty in turning the tables and revealing the many deficiencies of that career; no difficulty in showing how, on a closer inspection, the portrait which he has coloured so highly would fade into pale insignificance. But I value your esteem too much to wish to lower, even by a single tint, the picture which my friend has so flatteringly delineated. He must permit me, however, to complete his sketch by introducing into it the feeling of joyful gratitude with which I remember the countless manifestations of attachment I have received from all my English friends during my sojourn in this my adopted country. Their ever-ready counsel, their active support, their welcome sympathy, have never failed me on any occasion. And in glancing back at the many years of my happy labours in London, gemmed as this period is with delightful recollections, where could the expression of my gratitude find a more appropriate crystallisation-point, in which to centre, and from which to spread, than in our excellent President? He was among my earliest friends in this country, and, though he entered the College as a pupil, the brilliancy of his intellect, as well as the ardour of his aspirations, soon carried him far beyond that position, and placed him in the foremost rank of those who fostered the young and growing Institution in the early days of George Street and of Hanover Square. You all know these facts—you all know how soon his pupilage ceased, and how soon the student became the friend, the counsellor, one of the most able supporters of the new school—one of those to whose sound and practical advice we are so largely indebted for its safe steerage through the perils of its infancy. Truly, among the many feelings which affect me this evening almost overpoweringly, none is more joyful than that which moves my heart at the sight of my old and faithful friend presiding on this festive occasion—that well-tried friend whose hand was so frankly extended to me when first I reached the shores of this country, and now rests in mine with even warmer grasp on the eve of my departure. The delight I feel in seeing Mr. Warren De La Rue in the chair reminds me of another pleasure which you had destined for me by inviting Sir James Clark to this magnificent entertainment. I see the kindly countenance of our Chairman brighten at the very mention of the venerated name of his unremittingly active fellow-labourer in the cause of the College of Chemistry. That we are deprived of the pleasure of seeing him here this evening is owing to an attack of indisposition, from which, however, I am glad to say, he is now rapidly recovering. “You feel persuaded,” he writes to me, “that no trifling cause could have possibly prevented me from attending.” Of this I am perfectly sure, for no one was ever more deeply interested in whatever concerned

the College of Chemistry than Sir James, and no one would have been more gratified to meet so large an assemblage of friends of the Institution. Of the zeal and energy with which he has worked for the College, of the time he devoted to it in its earlier stages, of this, as of so much good which Sir James has silently and unobtrusively performed, no echo has ever reached the public ear; but the recollection will remain deeply and indelibly engraved upon many a grateful heart. And while speaking of the early days of the College, how could we possibly forget, on this occasion, the many, now no longer amongst us, whose warm interest and active help so essentially contributed to the success of the Institution? The noble-hearted Prince, whose loss we shall never cease to deplore, was a staunch friend of the College, the establishment and the progress of which he promoted by his illustrious patronage. As for myself, I am free to acknowledge that, but for his kind intervention, I should probably never have been connected with the Institution. Nor is it possible ever to forget the generous exertions in the cause of chemical education of the late Lord Ashburton, whose time, wealth, and influence were always at the disposal of our supporters. Nor was it only in its earlier stages that the College was fortunate enough to secure the co-operation of powerful friends. At no period of its history have they been wanting. When, at a later period, the College became connected with the School of Mines, it enjoyed the special care of the late Sir Henry de la Beche. Need I tell you how we have fared under the auspices of his successor, our beloved chief, Sir Roderick Murchison? Let a single example of our many debts to him suffice. It is to him that the College owes its convenient Lecture-room. Before this acquisition the chemical lectures were delivered, as many of us remember, in the Theatre of the Museum of Practical Geology; which was a very great inconvenience, both for the students and the Professor. Sir Roderick no sooner became the head of the Museum than he perceived this anomaly, and found means of obviating it. It may be, perhaps, that his anxiety to centralise the chemical department of the School of Mines in Oxford Street was sensibly quickened, on certain occasions, by the wafted perfumes of escaping chlorine; perhaps it was fanned to a still higher temperature by some fragrant developments of sulphuretted hydrogen; and I secretly believe that it rose at last to the boiling-point on the occurrence of a little phosphorus conflagration, which one fine evening startled the peaceful inhabitants of Jermyn Street. But whatever share sulphuretted hydrogen and phosphorus may have had in the transaction, thus much is certain, that without the energetic determination of Sir Roderick, without his unremitting zeal, without his powerful influence, the College would be still deficient in one of its most essential appliances. But, Gentlemen, I have told you enough of the help which the College has received from without. Let me now speak to you of the support which the Institution has found within itself. No external props will sustain the tree unless the vital juices circulate freely through root, and stem, and branches. Need I tell you, Gentlemen, that the best pillars of the College have been the students who sat upon its benches, who worked in its laboratories, and who afterwards applied the knowledge there acquired, the patient habit of research there contracted, to the promotion of science, to the advancement



of the arts, and to the benefit of mankind. And now, Gentlemen, I have reached a point at which I feel deeply the inadequacy of words to express the sentiment of proud delight, of joyous enthusiasm, with which I see myself surrounded this evening by this large assemblage of sometime students, many of whom were afterwards my assistants, all of whom are now my friends. In moments like this a man's existence is, as it were, concentrated; for, from the beaming eyes which meet mine, to whichever side they are turned, the happiest memories of my life come back, as if reflected from a mirror. Every face awakens a delightful tradition of years gone by, of successful collaboration, of mutual consolation in the hours of failure, of animated discussion, but always of good-fellowship and perfect understanding. Yes! this is indeed a golden moment, and one for which the labours of a lifetime would not be too high a price to pay. In glancing round this table my heart swells with an emotion of indescribable satisfaction. I see our beloved science of chemistry, as it were, vividly personified before me in all its noblest branches. I see here some of those who are gloriously devoting their laborious lives to the development of chemical philosophy—to the patient investigation of its recondite truths—to the discovery of new elements, to the revelation of new laws. In others here present I see represented the grand movement of industrial chemistry in our time; that movement which is covering Europe with factories, in which the transformations of matter are made subservient to the happiness of man. Prominent among such establishments are those from which innumerable exquisite colours are now so lavishly poured forth, to delight the eye and refine the taste of the masses with decorative splendours, which but a few years since even princes would have desired in vain. And as the word "princes" has escaped my lips, may I not venture to hint, in passing, at the lustre which science both gives and gains, when it sheds its light in palaces and receives the homage of "princes" in return? In such homage, nobly rendered, do we not recognise one of most marking signs of an age when all ranks unite in one ardent aspiration—to promote the happiness of humanity at large? But I am detaining you too long. "Out of the fulness of the heart, the mouth speaketh," and my heart is beating too high at this moment to be easily restrained. I would fain dwell upon the future of the College; I would fain stretch my vision through years to come, and forecast the destiny of an institution which will be dear to me as long as I live. That it will continually prosper, continually advance, the enthusiasm displayed in its behalf this evening would be earnest enough, were there not in its high mission, and in the abundant proofs of its utility, still stronger guarantees. It is with deep satisfaction that I reflect on the ability, so far superior to mine, of the distinguished chemist and esteemed friend who is about to preside over its destinies, and whose teaching, I have not the shadow of a doubt, will receive from the pupils of the Institution the same generous appreciation as you, my dear friends, in old student days, so affectionately accorded to me. But I must not enlarge on a topic which the programme, I see, reserves to be dealt with by abler hands; nor, indeed, must I any longer trespass on your indulgent attention. Let me, only for one moment, before I conclude, turn to those who represent here the rising generation of chemists, in order that I may point out to their emulation, the brilliant careers, and enviable positions, of distinguished men here present, but a few years since young students like themselves, now the conspicuous

ornaments of our profession. Into whatever department of our noble science the pupil's inclination or capacity may lead him, he will find in this assemblage abundant proofs of the pre-eminence which, by the exercise of similar ability with equal perseverance, it is open to the youngest in his turn to attain. . . . My dear friends, I am putting off, I feel, that painful parting word, Farewell! But it must come at last—and I pronounce it in its fullest, deepest sense—may you, all and each, Farewell! Believe me, in quitting the glorious country of my adoption, in quitting dear old England, I carry with me to my new sphere of labour some of the brightest, some of the most cheering memories of my existence; and among the most consoling of my thoughts at this moment is the reflection that I may still hope for the happiness of meeting you again!

The next toast was proposed by Mr. ABEL, who said:—There is probably no one of Dr. Hofmann's entertainers present this evening who does not experience, in some degree, feelings of affection for the institution in which we have all worked, and to whose existence we are indebted for our connexion, as his pupils and his friends, with the eminent chemist and teacher whom we delight to honour this evening. One is very apt to judge of other people's feelings by one's own, and I must say, and cannot help saying it now, that the six years which I passed at the Royal College of Chemistry were amongst the happiest years of my life. In company with Mr. Nicholson, I lately paid a visit to the Royal College of Chemistry on pleasant business connected with our meeting this evening, and in company with my old friend and colleague I once again, after an interval of many years, found myself in the old laboratory, the walls of which were blackened, not so much by age as by sulphuretted hydrogen. Once more I found myself on the old spot where I had many a time stood side by side with our great teacher, and where I can picture him to myself blowing softly and contemplatively into a watch-glass—(laughter and cheers)—looking intently into the dim distance at yet unformed crystals, which were to constitute some important member of one of the many "ammonia" families created and fostered by him, consoling himself that if they did not appear that day "he would have them to-morrow." (Laughter and applause.) As I looked round that room I could people each particular bench with a succession of well-known and well-loved faces—the faces of men with whom I had been associated year after year, some of whom had gone to far-distant lands, while others, alas! are now no more. The sympathies of Mr. Nicholson were more particularly directed to the very small and shabby room in which he had laboured indefatigably for years as the Doctor's right hand, and which has been the birthplace of most of those glorious researches with which Dr. Hofmann has delighted the world during the last eighteen years. Gentlemen, as I quitted the College that day, I thought, "Is it possible that the old place can ever get on without Dr. Hofmann?" So complete has been his identification with this institution, that it is almost impossible for me to think of them as otherwise than inseparable. We have heard from our Chairman of the difficulties with which the Doctor had to contend in the early part of his career in this country, and of the glorious manner in which he conquered those difficulties. He now leaves the College as a most successful Government establishment; but although its stability is secured, you will, I know, agree with me that its future position as a school of chemistry mainly depends on the manner in which the important trust of the prosperity of the Royal College of Chemistry is disposed of. And, therefore, gentlemen, all who have the welfare of the institution at heart must congratulate themselves in finding that trust confided to one of the most zealous and successful investigators of chemical science of whom England, or even the world, can boast. Gentlemen, I ask you to drink to "The future prosperity of the Royal



College of Chemistry," and to associate with this toast that of the health of Dr. Hofmann's successor, Professor Frankland. (Loud cheers.)

The toast having been duly honoured,

Professor FRANKLAND, in responding, said: When I look around me in this room and see the numerous assemblage of men who have studied in this Royal College of Chemistry; when I remember the position which they occupy at the present day; when I call to mind the researches which have been made in that institution; when I consider the influence which these researches have had upon the chemistry of the world,—how the practice of this our beloved science has to a great extent been moulded during the last twenty years by many of those researches—I cannot help feeling the responsibility cast upon the successor of the gentleman who has so successfully raised the institution to its present brilliant position. If earnestness of purpose and love for our science could secure success in carrying on this establishment during the absence of Dr. Hofmann, I should feel no fear of failure. (Hear, hear.) But, unfortunately, other qualities are necessary. There is the power of organisation, there is the method of management and the tact of arrangement in these matters, and last, though by no means least amongst them, is the sympathy of those who have been connected with such an establishment, and especially of those who have been connected as students with it. From the manner in which you have just drunk my health, I cannot but feel secure in this last help to my success. ("Bravo!" and cheers.) I am sure in this respect every student of the Royal College of Chemistry will do his best, by sympathy, by advice, and by suggestion to render possible the carrying on of this great school during what I may term its interregnum, in a manner which shall not, at all events, bring disgrace upon it. I hope, gentlemen, I may rely upon your sympathies and co-operation in this respect, and if I can do so I shall enter upon its duties with very considerable hopes of not, at all events, utterly failing in their performance. (Applause.) In conclusion, allow me to thank you for the very kind manner in which you have expressed your wishes towards me on the present occasion.

The CHAIRMAN said there was one thing not noticed in the programme, and that was, a kind proposal on the part of Mr. Belton to present each gentleman with an excellent photograph of their Professor. (Applause.) It suggested the thought that they ought each to present the Doctor with their photographs as a memento of the occasion. (Cheers.)

The photograph, a very excellent one, was taken by Messrs. Wilson and Beadell, of New Bond Street.

Dr. ODLING: The honourable task, the pleasant duty, has been assigned to me to propose that we should all of us unite with a heartiness and earnestness, only one degree inferior to that in which we have given welcome to our distinguished guest this evening, in drinking success to the Society in which he was so much interested, and of which he was so great an ornament—the Chemical Society. (Hear, hear.) We have heard Dr. Hofmann eloquently eulogised this evening as a great master; I have to propose that we should bear him in our memories as a great "Fellow,"—in fact, a grand Fellow of the Chemical Society. (Cheers.) We can call to mind many lively evenings which we have spent in his society, those in which he filled so well the dignity of the chair; but, at the same time, they were not the most lively, for I preferred to see him standing on the floor and expounding, with all the enthusiasm of his nature, some of those recondite problems which he knows so well how to illuminate; to see his face light up a touch of sympathy in his auditors, and his eloquent right hand protruding itself when he thought that they appreciated the point. ("Bravo!" and applause.) I say, gentlemen, we must bear in mind our distinguished friend not only as the teacher and philosopher, but as our Fellow on those

boards. But, Sir, my toast has reference not so much to the past as to the future; I have to call upon you to drink success to the Chemical Society—to its future career. I am sure that we shall all of us feel it a duty to support the Society with our most earnest efforts now that we feel how great a prop has been removed from it, at any rate for a short period. I am sure it will be a source of gratification to Dr. Hofmann, as it is to all of us, to feel that we have now occupying the chair so able a chemist and so accomplished a gentleman as Dr. Miller. We of the younger generation are deeply indebted to Dr. Miller, not only for the scope of learning which he has placed at our disposal, but also for the admirable example which he has set. Dr. Miller is not wedded to the notions which prevailed in olden times; but he has shown that he is seeking truth only, and truth for its own sake, and by so doing, with a large amount of industry and a large amount of activity, he has placed himself in the advanced guard in the progress of chemical science. Gentlemen, I call upon you to drink success to the Chemical Society, and to associate with it the name of Dr. Miller. (Applause.)

Dr. MILLER, in responding to the toast, said: I consider it an exceedingly happy circumstance that the lot has fallen to me to occupy the chair at the Chemical Society; and that it has been my good fortune by so doing to be able to be present at such a gathering as this. I have not had the honour of being one who has worked in his laboratory, and therefore, but for the accident of your having, a short time ago, been kind enough to place me in the chair, I should not have been able to have witnessed the enthusiasm which has greeted my admirable friend Dr. Hofmann from his old pupils on this occasion. It is a circumstance that cannot be effaced from the memory of any of us; as long as we preserve memory we shall preserve the recollection of this night. But, gentlemen, it is not my part to speak of the feelings which have filled my heart whilst I have listened to the address which we have had on this occasion. I am called upon to respond to a toast in which prosperity to the Chemical Society is the main staple. When I see around me so large a body of supporters of that Society, I believe that there have been within the last quarter of a century two great events in the chemical history of England—the one the establishment of the Chemical Society, and the other the establishment of the College of Chemistry, under the guidance of Dr. Hofmann. (Cheers.) Gentlemen, I may say those two events were necessary to each other. The one would scarcely have been a success without the other. Not that Dr. Hofmann would have failed—far from it; but in order that we may succeed we must have a sympathising audience, and such an audience was provided when the Chemical Society was established. Success naturally causes, as our friend says, crystallisation round a nucleus, and that nucleus here has been the Chemical Society. It gave us the opportunity of establishing what we have now—a chemical journal. It gave the opportunity of speedily promoting the knowledge of those discoveries which were made in the laboratory of the College of Chemistry and of other institutions, which speedily were stirred up to increased activity by the example there set. Before the establishment of the Chemical Society I believe we might have told off upon our fingers the names of the chemists of England. Since the day that we established that Society, this assembly represents but a small number of those who are engaged in pursuit of that noble science. (Hear, hear.) My friend Dr. Odling has alluded to the loss we are sustaining in the departure of Dr. Hofmann for a time from this country; but I hope that departure does not necessarily involve the loss of those admirable communications which he made, and which we hope he will continue for many, many years to make to our knowledge. As a great general society, we are entitled to have from him the first fruits of his labours. (Hear, hear.) Why should not this be the country in which his labours are given



to the world, although he considers it the prime duty of a patriot to stir up in Germany the flame which he has kindled in this country? Gentlemen, I hope, therefore, in losing Dr. Hofmann's bodily presence we do not lose his mental activity amongst us. For the future of the Chemical Society, I really feel very little fear. We are supported by chemists who are known throughout the world, and who are contributing discoveries of magnitude and importance week by week. Whilst those discoveries are going on, and whilst we have such officers as Dr. Odling and Dr. Frankland, with others whom it would be invidious to name, we can have no fear for the future of chemistry or of the Chemical Society in this country. I thank you most heartily for the kind manner in which my name was associated with this toast, and I thank those gentlemen who gave me the opportunity of being present on this occasion, and I hope we may welcome our friend back again as warmly as we celebrate his departure. (Cheers.)

The CHAIRMAN, in giving the next toast, said: If proof were required to be adduced of the value of the College teaching, of which we have already heard so much, it would be brought forward in the diversity of callings and social positions of its students. Without arrogating too much to ourselves, I think we may say that we form a glorious brotherhood, united by the love of truth; that we are an assemblage of men who have not shrunk from hearty, consistent work when any worthy object has been presented to us. (Applause.) It is not to be expected that in our after-career we can all devote the same time to abstract chemical research; but the high-born and those lower in the scale of social position must derive not only a new source of enlightened pleasure, but also a powerful means of effecting good from the study of so glorious a science (hear, hear). We have amongst us to-day three princes whose destinies time alone can unfold. (Cheers.) They have not deemed a knowledge of chemistry unworthy of a place alongside of their other high mental attainments; and I regard it as a gratifying symptom of this age that princes not only patronise science, but that they make themselves intimately acquainted with it. (Applause.) I would ask you to drink the health of our distinguished colleagues, their Royal Highnesses the Comte de Paris, the Duc de Chartres, and the Prince de Condé. (Cheers.)

The COMTE DE PARIS, in responding, said: Gentlemen, I did not come here to make a speech. Even if I am entitled to say anything about our beloved guest, I feel that it is unnecessary amongst you who know him and love him so well. Therefore I wish only to thank you in the name of my brother, the Duc de Chartres, and my cousin, the Prince de Condé, for the unexpected compliment which has been paid to us to-night, and to tell you how heartily we join with you in the mark of regard, admiration, and I dare say, of affection, which has been paid to Dr. Hofmann. (Cheers.) As foreigners in this country and strangers amongst you, we feel bound to you by one common feeling of gratefulness towards our former master. Therefore let us all join to tell him that whenever he comes back to this country, and we hope it may be soon, he will find as many friends amongst us here as he has ever had pupils during the long years he has sojourned amongst us. (Loud applause.)

Mr. NICHOLSON (who was greeted with loud cheering) said: Fellow students, as one of the oldest amongst you, I perhaps may have the privilege of speaking. I shall detain you but a few seconds, as I have the honour of proposing the last toast of the evening. I think, gentlemen, by the expression on your faces, I may say that this entertainment is a success. (Applause.) I think it is a success to Dr. Hofmann—(Cheers),—and I think it is a success to ourselves. If there is one person to whom we are indebted for this little gratification, it is to the exertions of our worthy Chairman, Mr. Warren De la Rue. ("Bravo" and cheers.) His many qualifications and his eminence as a

scientific man have been spoken to by Dr. Hofmann and others this evening; therefore I need not take up your time by at all mentioning my own opinions on the subject. It is sufficient for me to say that he is a well-known man, that if a letter were directed to him from the uttermost parts of the earth directed simply "Mr. Warren De la Rue, England," it would find him without a single hitch in the postal delivery. It is not as a scientific man I wish you to drink his health, but as president of this glorious entertainment this evening, and I know you will do this most enthusiastically, and, if I dare say it, let us drink it, as we used to do, of old, for "he is a jolly good fellow."

The toast was drunk with musical honours.

The CHAIRMAN: Gentlemen, if I could respond in music I would. (Laughter.) I assure you I thank you with all my heart for the cordial manner in which you have received the proposal of my much esteemed friend Mr. Nicholson to drink my health. My warmest sympathies are bound up with the welfare of the College, and I look upon the testimonial which I received in 1847 as one of the most gratifying recognitions of services rendered to science that I have ever received. This was given to me at the meeting presided over by his late Royal Highness the Prince Consort, and I keep it as a precious memento. Three names on the testimonial have passed away—the names of great friends to the College; and we shall all pass away, but when we are all gone, the College will still endure. But there is an immense amount of vitality yet in the College and in its pupils, and while we live I hope that we may often be brought together in such convivial evenings as the present. (Loud cheers.)

The company then dispersed with unmingled feelings of satisfaction at the success of the entertainment.

Great credit is due to Messrs. Abel, Nicholson, Maule, and Field, to whose exertions, as the Executive Committee, must be mainly ascribed the great *éclat* of this parting demonstration to Dr. Hofmann.

Mr. Harker officiated as toastmaster.

#### Additional Clauses for the Pharmacy Bill.—

The Leeds chemists and druggists have brought forward the following additions to the Pharmacy Bill:—Clause 1.—And it be enacted, that on and after the 1st day of January, 1866, the license, now known as the license for the sale of patent medicines, be discontinued and repealed, and in place of the aforesaid license, another license which for the purpose of this Act shall be called the "Pharmacy License" be substituted, the value of which shall not exceed 40s. Clause 2.—And be it also enacted, that any person or persons keeping open shop for the sale of drugs, chemicals, compounds, patent medicine, other medicine or medicines, or causing to be sold for the cure of disease or diseases, any such drug, chemical, compound, patent medicine, other medicine or medicines, not having taken out the said Pharmacy License, shall for each offence be subjected to a penalty of \_\_\_\_\_ for each offence, or twenty-eight days' imprisonment, as the magistrate or magistrates may direct. Clause 3.—And be it also enacted, that the meaning, rendering, or definition of the words, "drugs, chemicals, or compounds," shall be any article, simple or compound, named or described in the British Pharmacopœia, unless the said article be distinctly marked in a schedule to certify the free sale thereof. Clause 4.—And be it enacted, that all the essential clauses relating to the putting up for sale or illicit sale of patent medicines, shall be in all respects the same as the clauses already enforced in the Act now in use and known as the Patent Medicine License.

#### ANSWERS TO CORRESPONDENTS.

M. A. B.—Received.

A. B.—It is used cold. The price depends altogether upon the quantity required. It can be produced very cheap.

Excelsior.—Try a solution of gallate of iron in ammonia.

R. M. Atkinson.—Received with thanks. Came too late for any remarks this week.



# THE METALLIFEROUS MINES BILL.

WE have before us the Metalliferous Mines Bill brought in by Lord Kinnauld, and we consider it our duty to give an opinion on a subject so important to an art which was probably the parent of chemistry, and concerning which that science is still so much interested. To those who have read the report of the late Mines Commissioners it will be clear that many remediable evils were proved to exist. The Commissioners gave opinions concerning these remedies, and the Bill seeks to insist on their application.

We shall be grievously disappointed if English gentlemen and statesmen will allow another year to pass over without endeavouring to remove the dangers under which such an important part of the community are compelled to exist. We understand that the owners of and workers in mines are well pleased with the Bill, and that it would readily be passed if the Government did not oppose.

We may enumerate some of the demands:—That ventilation shall be sufficient; that mechanical appliances for lowering or raising men shall be used when the Board demands it (the Board of Trade is here meant); that ladders, ropes, &c., &c., shall be kept in good condition; that indicators shall show at what place of the shaft the lifting machine may at any time be; that it shall be supplied with a break (we suppose this is in cases where no man engine is used); that every skip or cage shall be covered when used for lowering or raising the miners; that single-linked chains shall be avoided; that proper fencing shall be made; that shafts shall be lined wherever the natural strata are insecure; that all shafts shall be fenced when a part is used for men and a part for other purposes; that every mine entrance, every shoot, winze, or sump not in use shall be covered; that sufficient accommodation be given for drying clothes and changing them; that steam engines shall be provided with water gauges and safety valves and with steam gauges or whistles; that the fly wheels shall be fenced; and that very young persons shall not work in the mine.

These general requirements are to be supplemented by rules made according to the requirements of each mine, which rules shall be made by the proprietors and shall require the sanction of the Board. If there is any dispute it is to be settled by arbitration. Probably such precautions to protect the proprietors from being compelled to act according to any unreasonable demands of any public officers were never before given in a Bill.

The plans of the mine are to be deposited at the office of the Board, if not already deposited at the Mining Record Office. Some confusion might arise from this, and it is, perhaps, too much to demand that two sets of plans shall be deposited. Perhaps it might be sufficient to say that plans shall be deposited if required; but this is perhaps of less importance.

For the purposes of the Act the Board may appoint such inspectors as are required to report on the condition of the mine and all matters relating to the safety and health of the miners. The Board will give such orders as the inspectors' report shows necessary, and if objection be made it is to be settled by arbitration, the Board

and the proprietoreach appointing an arbitrator, and both together an umpire. If this fails the Board may cause a second arbitration, and appoint two arbitrators and an umpire. The question to be settled in three months, unless the Board extends the time. We do not suppose that there are two opinions on the propriety of having the work done. Shall men be compelled to do it, or shall we leave it to their own good sense? It is rather strange to hear men speaking so, when it has been left to their good sense since the world began. We do not doubt the willingness of mine owners to do their work well, including attention to the men; but in most cases they do not know what to do. The value of inspectors consists chiefly in this, that they convey knowledge from place to place—knowledge of a high class, and in this case such knowledge as the Mining Commission have made public, but which we know, from experience, the proprietors of mines will not read, learn, and inwardly digest, unless they are assisted.

Men willingly receive the instructions of an inspector if given in a proper manner. They are glad to hear his experience, and they frequently find that he saves for them a considerable amount, as he shows the manner in which certain work can best be done, instead of leaving it to the owner to discover it for himself. The inspector may make himself a friend to all the proprietors and working miners, and be welcome wherever he goes. We are told of a mine belonging in part to a distinguished statesman, which was losing money for years; the precautions recommended in this Bill were taken, and the improved mechanical appliances used largely, and the mine is now paying its owners many thousands of pounds yearly. The humanity was carried out for money, but nature was kind, and took the *deed* for the *will*. We believe that the method of working mines spoken of is become a necessity if mining is not to cease in many cases. The time is past when carelessness or unwholesomeness can make a living even underground.

We are chemists, and must look on the matter as such. The inspectors appointed to superintend the ventilation must have chemical knowledge. Men have used their senses in various ways to ascertain whether a place is well or ill ventilated, but have failed. Now, however, we can tell by a simple experiment in a few seconds the exact condition of the ventilation. Chemistry is seizing more and more on the reins of industry, and directs it successfully where mechanics have failed and the senses have been uncertain. The evil is a chemical one, the cure must be chemical.

We believe the Board would have very little to do with the matter. The inspector would report to the owners first. Although this is not in the Bill, we think it advisable, and we believe that it acts best; the owner will see the reasons when they are pointed out for any change, and the inspector will only require to report to the Board that such changes are making or made. It is important to remember that much will depend on the character of the inspectors. If they report every little evil first to the Board, and cause a demand of change to be made, it may induce opposition. We as Englishmen believe we can be led by reason, but we are hard to drive. Let the instructions to the inspectors be that they are to teach the miners those facts and principles which a careful public inquiry has shown to be conducive to their welfare. The miners themselves, masters and men, will be the chief gainers, but the whole community will gain, and the mining speculations will less often be merely modes of absorbing the surplus money of the community.



SCIENTIFIC AND ANALYTICAL  
CHEMISTRY.

*On a Yellow Colouring Matter from Rosaniline, by*  
MAX VOGEL.\*

WHEN a strong stream of nitrous acid is passed into an alkaline solution of commercial fuschine or pure rosaniline some magnificent colour phenomena are observed. In a short time the red colour passes to violet, and this to a beautiful blue; by the continued action the blue changes to green. On allowing the green solution to stand for some hours, the green colour changes to a beautiful reddish yellow, but this change may be quickened by continuing to pass the nitrous acid. The colour undergoes no further alteration, and on evaporating this solution on a water-bath a reddish-brown pasty mass is obtained, which hardens on cooling, and when cold can be reduced to a beautiful cinnabar red powder.

The author has made one analysis of this powder, from the results of which he deduces the formula  $C_{16}H_8NO_6$ .

The new colouring matter behaves as a base and as an acid. It dissolves with some difficulty in dilute, easily in concentrated acids, but more easily still in alkalis. Acids separate it from alkaline solutions, the colour floating on the surface of such solutions as a flocculent mass. The colour dissolves in alcohol, sulphide of carbon, chloroform, and ether, but is insoluble in water.

The author intends to continue the study of this body and to make experiments on the action of nitrous acid on aniline blue, violet, green, &c.

*Researches on Cerium,† by R. HERMANN.*

RAMMELSBERG having published (*Repertoire de Chimie pure*, ii., 6) a paper on cerium, the results of which do not agree with those previously arrived at by the author in 1843, the latter has undertaken some new researches on oxide of cerium.

**Sesquioxide of Cerium.**—Sesquioxide of cerium is formed by the calcination, in contact with the air, of a mixture of ceroso-ceric sulphate and carbonate of soda; 58.785 per cent. of oxide  $Ce_2O_3$  is thus obtained. On the other hand, 100 parts of the same salt furnish, after being dissolved in sulphuric acid, and calcined, a quantity of sulphate corresponding to 54.881 of protoxide of cerium; it follows that 100 parts of protoxide correspond to 107.11 parts of sesquioxide of cerium, these figures agree well with the equivalent 46 of cerium ( $H = 1$ ).

Concentrated sulphuric acid partly decomposes this oxide, giving a ceroso-ceric sulphate of variable composition.

Again, sesquioxide of cerium is formed by the action of heat on cerous oxalate in presence of air. Rammelsberg has admitted that in this case the oxide  $CeO.Ce_2O_3$  is formed.

**Peroxide of Cerium (Ceriumsupersuboxide).**—The author formerly obtained by calcining cerous nitrate, an oxide superior to the sesquioxide, and having the composition  $2Ce_2O_3.CeO_2$ .

This is also formed by calcining sesquioxide in a current of oxygen, while Rammelsberg admits that in this case an oxide is produced  $(CeO)_2(Ce_2O_3)_5$ .

The author attributes this opinion to Rammelsberg's having regarded the sesquioxide, obtained by the

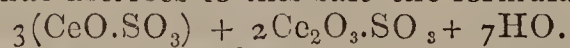
calcination of the oxalate, as ceroso-ceric oxide. The density of this peroxide of cerium is equal to 5.759, while that of the sesquioxide is equal to 6.0. Sulphuric acid decomposes peroxide of cerium, disengaging oxygen, and giving a mixture of cerous and ceric sulphates.

Sesquioxide of cerium treated by sulphuric acid gives a mixture of red and yellow sulphate in varying proportions, and at the same time oxygen is disengaged. These two sulphates crystallise separately.

**Red Sulphate.**—This salt, crystallising in hexagonal prisms, resembles bichromate of potash. The first analyses of this salt led the author to assign to it the simple formula  $Ce_2O_3.3SO_3 + 9HO$ . M. Marignac supposed it to contain cerous oxide, and M. Rammelsberg gave it the formula  $3(CeO.SO_3) + Ce_2O_3.3SO_3 + 18HO$ . The author's more recent researches have changed this formula to  $2(CeO.SO_3) + Ce_2O_3.3SO_3 + 27HO$ , of which the numbers agree better with those of M. Rammelsberg than the formula given by this chemist.

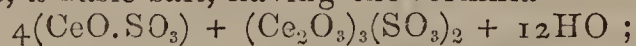
**Yellow Sulphate.**—This salt, which is deposited from the mother liquors of the preceding, crystallises confusedly. M. Rammelsberg attributes to it the formula  $CeO.SO_3 + Ce_2O_3.3SO_3 + 8HO$ ; and the author gives the following:— $2(CeO)_2(SO_3)_3 + 3(Ce_2O_3.3SO_3) + 42HO$ . It has probably no invariable composition.

**Basic Ceroso-ceric Sulphate.**—This salt is formed by the action of water on acid sulphate; in colour it resembles precipitated sulphur; its composition varies with that of the acid sulphate from which it is formed. M. Marignac ascribes to this salt the formula



and M. Rammelsberg  $2(CeO.SO_3) + 2Ce_2O_3.SO_3 + 6HO$ .

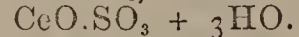
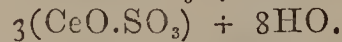
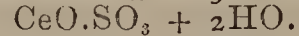
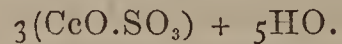
The author has obtained, with red and with yellow sulphate, a basic salt, having the formula



and with ceroso-ceric sulphate, containing  $CeO.Ce_2O_3$ , another salt  $3(CeO.SO_3) + (CeO)_3(SO_3)_2 + 5HO$ .

**Cerous Sulphate.**—Cerous sulphate combines with different proportions of water. MM. Otto and Beringer have described a sulphate  $2(CeO.SO_3) + 3HO$ .

By treating calcined cerous sulphate, which is more soluble cold than hot, by a very little water, we obtain, by gradually raising the temperature, four different salts containing—



When once a crystal is formed in a solution all that follow are of the same composition; unless, indeed, the mother liquors are decanted, in which case crystals of different composition may be formed.

The salt with five-third equivalents of water forms prisms grouped in bundles; exposed to the air, these crystals lose their transparency, and absorb water.

The salt with two equivalents of water forms rhomboidal prisms, also in bundles, and losing their transparency by exposure to the air.

The salt with eight-thirds of water is most frequently produced; it forms short, thick, rhomboidal prisms, which do not change in the air. Its composition corresponds to that of sulphate of didymium with eight-third equivalents of waters; but differs from it in its crystalline form, as it crystallises in the monoclinic system.

The salt with 3HO has been frequently observed, especially by M. Czudnowicz; it is in the form of prisms with six sides, surmounted by a pyramid; it does not alter in the air.

\* *Journal für Praktische Chemie*, vol. 94, p. 128.

† *Ibid.*, cxii., 113.



## TECHNICAL CHEMISTRY.

*On the Chemical Effects of Incandescent Fuel on Steam Boilers, and the Chemical and Physico-Chemical Effects of the Feed water, by F. A. PAGET, Esq., C.E.*

WE extract the following from a very valuable paper "On the Wear and Tear of Steam Boilers," read by the author before the Society of Arts:—

Whatever physical changes may be induced in iron by the long continuance of a high temperature which is not succeeded by the application of the impact of the hammer or the pressure of the rolls, it is certain that long continued red heat leads to the loss of its metallic consistency. Its surface gets converted to a greater or less depth into forge scales, which, according to Berthier, consist of a crystallised compound of peroxide and protoxide of iron. The mechanical action of the gases—and especially of the free oxygen contained in every flame—forced at a high velocity by the draught past the more or less heated plates, would also aid these chemical combinations—upon the same principle as iron filings, thrown through a gas flame, burn in the air; and upon the same mechanical principle as the incandescent lime is worn away by the flame of the oxyhydrogen blow-pipe. These actions would take place with any fuel, even with pure charcoal. But when mineral fuel, which mostly contains more or less iron pyrites, is used, there is much more danger to the plates, especially over the fire, in getting red hot, as the flames would then hold sulphurous acid, and often volatilised sulphur. A familiar illustration of an action of this kind is afforded by the fact that a piece of red-hot iron plate can be easily bored through by means of a stick of sulphur, the combination forming sulphide of iron. Dr. Schafhaeutl, of Munich, has given great attention to the changes in plates subjected to the action of fire; twenty-five years ago he read a paper before the Institution of Civil Engineers,\* and more recently he has published an essay, both on this subject, in a Munich periodical.† He has brought forward a number of facts, founded on chemical analyses of plates of exploded boilers, showing the danger, due to chemical action alone, when the plates of a boiler become red hot. He notices that the iron of the inside of the plates, in getting red hot, decomposes the water, and combines with the oxygen thus freed. It also loses some of its carbon. The outside combines with the free oxygen and with any sulphurous acid in the flame. He states that iron made with pit coal is much more affected than charcoal-made iron; becoming laminated at the original joints in the pile out of which the plate has been rolled. It is possible that portions of oxide are carried into these joints, and it is at any rate certain that iron gives way easiest at these places. This points to the great value of really homogenous plates, such as those of cast steel, in which homogeneity has been obtained by the only known means of fusion. The remarkable diminution of elasticity and of tenacity caused by the combination of the red-hot iron with sulphur; the absence of all elasticity and tenacity in the oxides of iron, show that, even if a flue do not at once collapse, or a shell explode, through getting red-hot, the boiler is more or less injured every time it gets overheated. A defective circulation, by permitting such a temperature as to drive the water off the plate, would soon lead to local injury. Particular spots in externally

fired cylindrical boilers are sometimes, as is stated by Mr. L. Fletcher, of Manchester, thus affected, and in an apparently mysterious way. A new boiler in which a heap of rags were accidentally forgotten, had the spot burnt out in a few days,‡ doubtless through the resulting defective circulation and its consequences. The plates just above the fire of internal flues also suffer in this manner. It is perhaps possible that turned joints, secured by bolts, and allowing an occasional reversing, or rather rotating, of the ring, might, in some cases, be here of service. At any rate, universal experience proves that the thicker the plate the easier does it get red-hot; and these chemical facts also point to the desirability of a minimum of thickness. In fact, the wearing away of the plates through these causes, if mechanically strong against pressure, often gets arrested at a certain thickness. In Germany and France, some of the best manufacturers still make the plates over the fire of, for instance, inside flues, slightly thicker than anywhere else; but the combined chemical and mechanical actions of the heated fuel cause most wear and tear in a thick plate, and thus justify American practice in this respect. In that country, fire-box plates of good charcoal iron are made only  $\frac{1}{16}$ th or  $\frac{1}{4}$ th of an inch thick, and, with stays four inches apart, give good results under nearly 150 lbs. steam pressure.

The wear and tear of a boiler which occurs in the form of corrosion, properly so-called, may be divided into two principal kinds:—(1.) Internal, and (2.) external. The progress of both is necessarily intensified by the mere effects of temperature; each, however, has its strongly-marked, distinct character—not merely as to position, but also as to origin and results.

A steam boiler is in the position of a vessel into which large volumes of water are continually forced; while the heat applied, driving off all volatisable matter, leaves behind a concentrated solution with a chemical character dependent on that of unvolatisable matters in the feed water. The specific gravity of the substances found in the water naturally causes them to sink towards the bottom, at which part the solution is generally more concentrated, however much it may be stirred up by the ebullition. Mr. J. R. Napier lately stated that a piece of zinc "about four feet long, by three inches broad, by three-sixteenths thick, placed in a marine boiler for three weeks" to a depth of eighteen inches in the water, showed a corrosion which rapidly decreased "up to the highest part, which, in the steam, appeared to be little affected."§ This accounts for the fact that all boilers, even those internally fired, like locomotive boilers, have their plates most affected towards the bottom, and that internal corrosion always shows itself to a greater extent below the water line. The *boilleur* of the form of boiler known as the French boiler is also generally more affected than any other part. To resist this sort of slow action, it is clear that the more the bulk of metal the better, and it is for this reason that the bottom plates of most marine boilers are made thicker, while these same plates in locomotive boilers have to be often renewed. Any chemical or physico-chemical action of the kind is of course intensified by temperature, and this is one of the causes why externally fired boilers give way most a little in front of the furnace. But the plates above the water-line also get more or less corroded, and not merely with the usual character of rusting, but in that peculiar form known as pitting, which generally

\* Transactions of the Institution of Civil Engineers. Vol. iii., 1840, p. 435.

† *Bairisches Kunst und Gewerbeblatt*. June, 1863.

‡ Péclet, "Traité de la Chaleur." Vol. ii., p. 73.

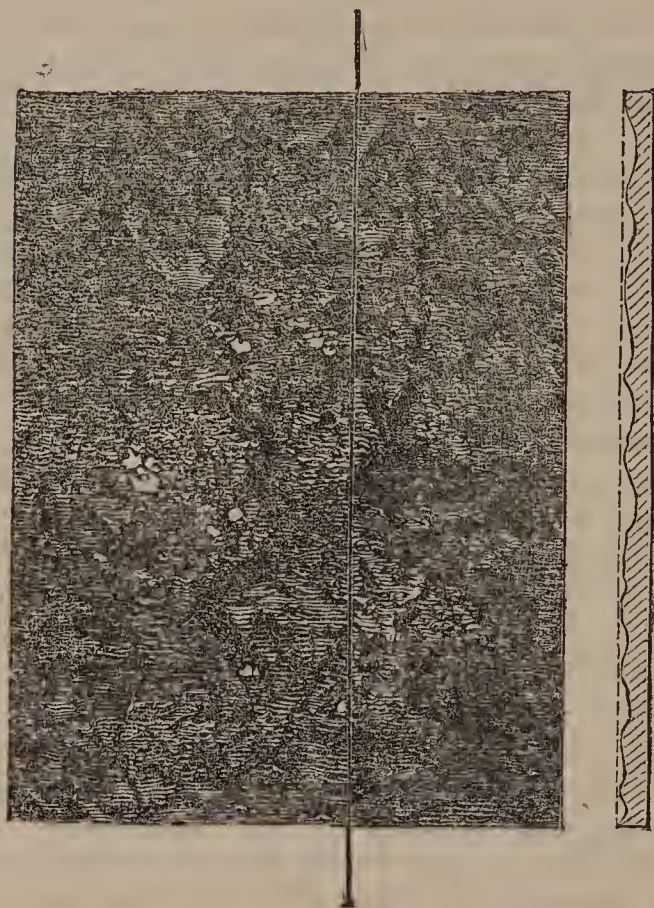
§ Institution of Engineers in Scotland, Session 1864—5.



shows itself much more strongly marked below the water-line.

The presence of a concentrated solution of an acid or alkaline character, kept at a high temperature for years in contact with iron plates, would be sufficient to account for much corrosion. But the internal corrosion of steam boilers has many features of such a mysterious character, that no accredited explanation of its attendant phenomena has yet been put forward. In the first place, plates thus attacked show a number of irregular holes like a pock-marked human face, or like the small craters seen on the moon's surface. (See Fig. 1.) The writer has

FIG. 1.



The internal surface of a plate of an old wrought iron boiler, showing one-quarter of the full size, the ordinary appearance of pitting.

also sometimes observed two or three little irregular excavations like this in a plate otherwise showing a large surface quite intact. Sometimes the plate is most pitted round a projecting bolt; at others, one plate will be perfectly sound, while that rivetted to it will be almost eaten away, both having been the same time at work, and under, of course, apparently exactly similar conditions. With locomotive boilers this pitting has been ascribed to galvanic action between the brass tubes and the iron plates. But it is notoriously well known to locomotive superintendents, that boilers with iron tubes are often worse pitted than those which have run the same distance with brass tubes. Besides, all iron boilers, with or without brass, whether used for stationary, locomotive, or marine purposes, are subject to pitting.

(To be continued.)

**Ammonia and Nitric Acid in Hail.**—We have mentioned before that Professor Reichardt has discovered the presence of nitric acid and ammonia in hailstones, and now only give his numerical results. In a million parts of hail he found 3.247 ammonia and 0.526 of nitric acid. These determinations agree closely with those of Boussingault, who found in a million parts of rain water 2.08 ammonia and 0.83 nitric acid. Professor Reichardt also determined the specific gravity of the hailstones. Two kinds fell, one opaque, and the other glassy and transparent; the former had the sp. gr. 0.9234, the latter 0.9285.—*Chem. Central Blatt*.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, May 4.

Professor W. A. MILLER, M.D., F.R.S., President,  
in the Chair.

THE minutes of the previous meeting having been read and confirmed, and a long list of contributions to the Society's library duly acknowledged, Mr. Arthur S. Hobson was formally admitted a Fellow, and signed the statute book. The ballot was taken for the election of Dr. Holzmann, Marlborough House; Mr. Joseph Sugden, jun., Halifax; and Mr. Thomas Nesham Kirkham, Gilston Road, West Brompton—all of whom were declared to have been unanimously elected Fellows of the Society. The name of Mr. William A. Tilden, Demonstrator of Chemistry in the Laboratory of the Pharmaceutical Society, was proposed for the first time, and the certificates in favour of the following candidates were read for the second time—viz., Mr. Thomas Fairley, Medical School, Leeds; Mr. Edward Swann, Director of the Laboratory at the London and North Western Railway Company's Works, Crewe; and Mr. Alfred Upward, Superintendent of the Chartered Gas Works, 148, Goswell Street, London.

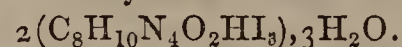
A paper on "*The Phosphide of Magnesium*," by Mr. THOMAS P. BLUNT, was read by the SECRETARY. The author prepared this substance by passing the vapour of phosphorus over heated magnesium filings in an apparatus, filled, in the first instance, with carbonic acid gas. The heated metal became incandescent in the act of combination, but a small proportion of magnesium usually escaped the action of the phosphorus; the author found, however, in a carefully conducted synthetical experiment, that 2.4 grains of magnesium absorbed exactly two grains of phosphorus; the percentage composition of the product was therefore—

Magnesium	.	.	.	.	54.54
Phosphorus	.	.	.	.	45.46

Numbers which agreed pretty closely with the formula— $Mg_3P$ .

In the state of purity the phosphide had the general appearance of lamp black, and was found to be remarkably permanent, so much so that hydrochloric acid failed in exerting any action upon it, and it was only by long boiling with nitro-hydrochloric acid that it underwent solution. If, however, a mixture of the true phosphide, with excess of metallic magnesium, were acted upon by dilute hydrochloric acid, a copious evolution of non-inflammable phosphoretted hydrogen ensued.

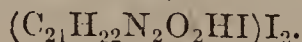
The next communication, entitled "*On the Periodides of Some of the Organic Bases*," by Mr. WILLIAM A. TILDEN, was also read by the SECRETARY. The author had made experiments, which resulted in the discovery of several new compounds, having a constitution very similar to that of Dr. Herapath's iodo-sulphate of quinine, and possessed of like optical properties. The first of these was made by mixing an alcoholic solution of caffeine with hydriodic acid and exposing for some time to the air, when a gradual separation of beautiful metallic green prismatic crystals was the result, the analysis of which led to the formula



On attempting to prepare this body by the direct action of iodine (dissolved in alcohol) upon the sulphuric or hydriodic acid solution of the base, the author obtained small black granules, which contained 75 per cent. of iodine, or an increase of 12 per cent. upon the amount found to be present in the lustrous green crystals. By the use of a standard solution of hyposulphite of sodium, it was ascertained that a certain proportion of the iodine—viz., two-thirds—existed in a free state, or "*exterior*" to the original molecule, and, therefore, in a condition under



which it was recognisable by starch. By heating caffeine with iodide of ethyl to the temperature of  $130^{\circ}$  C. for about four hours, hydriodic acid was formed with liberation of a little free iodine, and a liquid product obtained, which, upon evaporation, furnished brilliant brown scales of a permanent character, and insoluble in water. Its analysis indicated the formula  $(C_8H_{10}N_4O_2C_2H_5I)_2$ . A corresponding periodide of methyl-caffeine was formed with even greater facility than the body last named. Lastly, the author had prepared and submitted to analysis the iodo-strychnine of Pelletier, and proposed for this substance a formula containing one atom of hydrogen more than formerly admitted; thus—



Several experiments were made upon aniline and other organic bases with the view of obtaining combinations of a similar character, but the results were either indefinite or altogether unsuccessful.

In answer to an inquiry on the part of the PRESIDENT, Mr. TILDEN said he had not yet examined the optical properties of the teriodide of tetrethylammonium, and could not say whether or not the crystals were suitable for use as artificial tourmalines. In reply to Dr. Redwood, the author stated that he had been unsuccessful in producing Herapath's salt by the addition of iodine to the hydriodate of quinine; the employment of the sulphate of this base appeared to be absolutely necessary.

The proceedings were brought to a close at an early hour, and the meeting adjourned until the 18th inst. It was announced that on the occasion of the next succeeding meeting, June 1, the President would bring forward for discussion "*Some Points in the Analysis of Potable Waters.*"

## ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"On the Food of Man in relation to his Useful Work." By LYON PLAYFAIR, C.B., LL.D., F.R.S.

1. The great generalisation of Liebig, that food contains two chief classes of organic ingredients, one class consisting of nitrogenous substances, which give the plastic materials for the formation of tissues, while the other class contains the amylaceous and saccharine bodies destined to support the heat of the animal body, has met with general acceptance, notwithstanding the objections entertained by some physiologists to the general terms of the division. They state that the nitrogenous aliments may also support animal heat, as well as fulfil their special function of forming the tissues. But the distinguished author of the classification admitted this fact in his first work,\* when he pointed out that the carnivora must waste their tissues in the support of animal heat. The recent experiments of Bischof and Voit,† and of Pettenkofer and Voit,‡ in feeding animals on flesh from which all fat had been removed completely prove that nitrogenous substances can act as heat-givers as well as flesh-formers. But the converse of the classification is not true, for we have not the slightest evidence to show that alimentary bodies free from nitrogen can build up any organ of the body. It is known that a small quantity of fat is always present in healthy tissue, but it may be wholly removed by ether without injury to the organic structure. The same experiments which proved that flesh-formers might when necessary act vicariously as heat-givers, have also proved that the nutrition of carnivora may be effected without the supply of fat or any other non-nitrogenous body.

2. The chief object of this lecture is to examine the function of nitrogenous ingredients of food, as a magazine

of force for the production of dynamical effects in the animal. The consideration of the animal body as a machine, and of the food in the light of fuel supplied to it, has already engaged the attention of philosophers. Rumford,§ Joule,|| Mayer,¶ Helmholtz,\*\* Dumas,†† Hirn,‡‡ Fick,§§ and Carpenter,||| have published their views on this important subject, but all of them, so far as I know their writings, have looked upon food in its aggregate, applying their calculations to the total carbon and hydrogen contained in it, without discussing the influence exerted by its separate constituents in the production of force.

3. The Rev. Dr. Haughton, of Dublin, has been an exception in this respect. He has endeavoured to find in the urine the representative of the mental, vital, and mechanical work of the human body, and gives the following equations:—¶¶

$$\begin{array}{l} \text{Opus Mechanicum, or 150 } \left. \begin{array}{l} \text{lbs. raised one mile} \end{array} \right\} = 136.5 \text{ grains of urea.} \\ \text{Opus Mentale, or five hours } \left. \begin{array}{l} \text{of study.} \end{array} \right\} = 217.0 \text{ " " } \\ \text{Opus Vitale, . . . . .} = 297.0 \text{ " " } \end{array}$$

He then draws the conclusion that in manual or routine bodily labour, men are sufficiently well fed when they receive as much food as will discharge 400 grains of urea daily (the product of 2.8 oz. of flesh-formers), of which 300 grains are spent in vital work, and 100 grains (the product of less than three-fourths of an ounce of flesh-formers) in mechanical work. But when the work is of a higher order, Haughton states that a better quality of food must be supplied, sufficient to allow a discharge of 533 grains of urea daily, of which 300 grains are spent as before in vital work, and 233 grains in the mental and mechanical work necessary to keep the body in health.

4. If we are to understand these numbers of Haughton as being true exponents of the quantity of tissues necessary to be transformed for the production of force, the latter can readily be calculated and compared with that necessary to effect the work. Urea can only be an exponent of work, inasmuch as it shows us the quantity of tissue which has become oxidised in its production, and thus enables us to express the amount of energy stored up in that tissue, and in the oxygen which transformed it. Now, as 136.5 grains of urea are said to be equal to 150 lbs. weight raised to the height of one mile, we ought to find at least this amount of potential energy in the 405 grains of tissue from which the urea must have been derived, and in the oxygen required to convert it into this diamine. After deducting the hydrogen which may be supposed to have already met with oxygen in the tissues, we have available for transformation—

$$\begin{array}{l} 190.6 \text{ grains of carbon.} \\ 12.5 \text{ " hydrogen.} \\ 5.1 \text{ " sulphur.} \end{array}$$

These numbers, by the usual formula, would give 498.8 lbs. of water raised  $1^{\circ}$  F., and this, converted into its mechanical equivalent by the co-efficient 772, represents 385,073 lbs. raised to the height of one foot. This, then, represents the total potential energy, while the actual work realised by the man is more than double this amount, or is 792,000 foot-pounds. It is clear, then, that Haughton cannot have meant the equations given by him in the mathematical sense of equality, but only in the

§ Rumford's Essays, vol. ii., p. 488.

|| Joule and Scoresby, *Phil. Mag.*, 1846, p. 454.

¶ Mayer, *Die organische Bewegung in ihrem Zusammenhang mit dem Stoffwechsel*, 1845.

\*\* Helmholtz, *Lectures at Royal Institution* (Lect. vi.), 1864.

†† Dumas, as quoted by Matteucci, *Phy. Phen. of Living Beings*, p. 325.

‡‡ Hirn, *Théorie Mécanique de la Chaleur*, p. 34.

§§ Fick's *Physiologie des Menschen*, p. 291.

||| Carpenter's *Jour. of Science*, 1864, p. 266.

¶¶ Haughton on *Healthy Urine of Man*, p. 32.

\* *Animal Chemistry*, p. 120.

† *Die Gesetze der Ernährung des Fleischfressers*, p. 56, et seq.

‡ *Ann. der Ch. und Pharm. Supp. Bd.*, 1863, p. 361, et seq.



general sense of representation. In fact, in a further paper\* he points out that the combustion of the carbon and hydrogen of the proteine compounds can only account for 54 per cent. (misprinted 34 per cent.) of the work ascribed to the urea. Hence we are obliged to class Haughton with the other writers, who consider that the transformation of the nitrogenous tissues is insufficient to account for the dynamical movements of the body.

5. In discussing this subject anew, I divide the work performed in the body as follows:—

1. Mental work.
2. Calorific work.
3. Internal dynamical work.
4. External „ „
5. Digestive or assimilative work.

With the two first divisions we have little to do in the present lecture; with the three last divisions we shall be fully occupied.

6. It will be convenient to proceed in the following order:—

#### DIVISION I.

A. To ascertain the amount of food necessary for mere subsistence without exercise.

B. To determine the amount of food required for complete health, with a moderate exercise of from five to seven miles daily.

C. To fix the amount of food suited for active work, such as is represented by a man walking twenty miles daily continuously.

D. To find the amount of food consumed by labourers with very arduous occupations, such as navvies engaged on railways.

Having ascertained these preliminary facts, which are altogether independent of theory, we shall then be in a position to proceed to

#### DIVISION II.

A. To discuss whether there be sufficient potential energy in the nitrogenous tissues, or of the food representing them, and in the oxygen required for their transformation, to account for the dynamical actions within or without the body.

B. To consider whether the fatty and amylaceous or saccharine ingredients of food are employed in this mechanical work.

Having discussed these points, we should then be in a position to proceed to—

#### DIVISION III.

A. To inquire whether the secretions of urea and uric acid *per vesicam* are sufficient representatives of labour performed.

B. To consider what is represented by the nitrogenous materials secreted *per anum*.

#### DIVISION I.

##### *Food Required under Different Conditions of Work.*

7. In determining the amount of food required for mere subsistence, we ascertain at least approximatively, that necessary for internal dynamical work. By that we mean such work as is carried on within the man independently of the will, and in the direction of which he is an unconscious agent. The heart beats, the blood circulates, the lungs play, the diaphragm acts, the intestines exert their peristaltic motion, by an inner directive movement. In the exercise of these motions a certain amount of force is expended, but it is ultimately converted into heat, and aids the *opus calorificum*, which is chiefly produced by the combustion of the non-nitrogenous parts of food.

In looking for a purely subsisting diet, we naturally turn to the experience of hospitals having convalescent patients unable still to take exercise. The following is

the dietetic value in ounces of the “common diet with bread,” employed at the Infirmary in Edinburgh.†

Flesh-formers	. . . . .	2.06 oz.
Fat	. . . . .	0.58 „
Starch	. . . . .	11.33 „
Starch equivalent of heat-givers	. . . . .	12.69 „
Mineral matter	. . . . .	0.35 „

In this diet the amount of carbon in the flesh-formers is 1.08 oz., and in the heat-givers 5.57, or together, 6.58 oz. This amount of carbon fairly represents that required to keep up the vital actions, for Dr. E. Smith‡ found, in his own case, that 6 oz. of carbon were exhaled by him during one day's starvation, and Ranke,§ in a three days' trial, found 6.4 oz. every twenty-four hours. We may therefore assume that 6.5 oz. of carbon are required to support the life of an adult man without exercise. In the following table are some recorded instances of deficient dietaries, although in some of the cases they were only defective because work was expected from the persons living upon them. They are therefore generally sufficient for mere subsistence during rest, but insufficient for the performance of labour.

An examination of the information furnished by this table will justify the conclusion that though 2 oz. of flesh-formers, 0.5 oz. of fat, 12 oz. of starch and sugar, containing a total amount of 6½ oz. of carbon, will suffice for a man to support the internal dynamical motions and other vital necessities of his body when he is at complete rest, they are not compatible with a moderate amount of exercise; so that, even in the condition of low health without activity, 2.5 oz. of flesh-formers, 1 oz. of fat, 12 oz. of starch, and 0.3 oz. of mineral matter are necessary. This diet contains 7.44 oz. of carbon.

Table I.—Subsistence and Low Dietaries.

Flesh-formers	. . . . .	2.33
Fat	. . . . .	0.84
Starch, &c.	. . . . .	11.69
Starch equivalent	. . . . .	13.68
Carbon	. . . . .	7.469

8. We have now to get a mean dietetic value for the food of an adult man in active health, but without hard labour. The dietaries of soldiers during peace offer us a large experience. I have recalculated the following table, which was published formerly by me in a less complete form,|| taking bread as containing 37 per cent. of water.¶

Table II.—Dietaries of Soldiers during Peace.—Mean of English, French, Prussian, and Austrian Soldiers.

	oz.
Weight of solid food	. . . . . 51.0
Flesh-formers	. . . . . 4.215
Fat	. . . . . 1.847
Starch, sugar, cellulose, etc.	. . . . . 18.690
Starch equivalent of heat-givers	. . . . . 22.059
Mineral matter	. . . . . 0.714
C carbon in flesh-formers	. . . . . 2.267
C' carbon in heat-givers	. . . . . 9.720
Total carbon C + C'	. . . . . 11.987
Ratio of C : C' 1 : x	. . . . . 4.290
Ratio of flesh-formers to starch equivalents, 1 : x	. . . . . 5.237

The mean of this table may fairly be taken as representing the value of food required to keep adult men in good health. Army Surgeons state that the diet of our own soldiers, which does not differ widely from the mean, is not sufficient for recruits during their drills, though the sergeants fatten upon it. As the average value is also nearly the same as that of middle-class diets,\*\* we may

† The ounce used in this lecture is always 437.5 grains, or 28.35 grammes, the gramme being taken at 15.43 grains.

‡ Smith, *Trans. Roy. Soc.*, vol. cxlix., p. 681.

§ Ranke, *Müller's Archiv.*, 1862, s. 342.

|| *Good Words*, January, 1865.

¶ Lawes and Gilbert, *Chem. Soc. Journ.*, x., 54.

\*\* *Good Words*, February, 1865.

\* Haughton on Diabetes Mellitus, p. 30.



safely assume it to be a correct expression of the diet of men who live well and take moderate exercise, of from five to seven miles daily.

9. Before we discuss the dietetic value of food required for men engaged in labour, we must define what we understand by a full day's work. We take such work, when performed continuously throughout the year, with rest on Sundays, to be represented by a daily walk of twenty miles. The experience of postmen in rural districts shows that more than this amount of work cannot be executed without breaking down. As the co-efficient of traction is nearly  $\frac{1}{20}$ th the weight of a man's body, the work which a standard man of 150 lbs. has to perform is 792,000 foot-pounds. That this is a full estimate will be apparent from the following table †† of the work of a man under different conditions:—

Kind of Labour.	Amount of Work in ft. Tons.	Authority.
Pedestrians . . . . .	353	Haughton.
Pile-driving . . . . .	312	Coulomb.
" . . . . .	352	Lamande.
Turning a winch . . . . .	374	Coulomb.
Porters carrying goods and returning unloaded . . . . .	325	"
Porters always loaded . . . . .	303	"
Porters carrying wood up stairs, descending unloaded . . . . .	381	"
Paviours at work . . . . .	352	Haughton.
Prisoners at shot drill . . . . .	310	"

Mean, 340.2 tons = 105,605 metre kilogrammes. The mean of this table gives 762,048 foot-pounds. A man's labour differs within a tolerably wide range, according to the manner in which it is exerted, for while it may not exceed 480,000 foot-pounds in hammering, it may reach to 1,500,000 foot-pounds when pushing or pulling horizontally. ‡‡ Hence the amount of 792,000 foot-pounds taken for a day's work, may be considered a full, though not an excessive amount.

This estimate receives further support when we examine the work performed by soldiers in war. In Sherman's famous march from Atlanta to Savannah, twelve miles daily were accomplished. In war, the Prussian army walks fourteen miles daily, resting every fourth day. In our Indian marches, twelve miles daily, with the same rest, is the work allowed to the troops. Hence, if we take full war work as represented fourteen miles' daily continuous marching, the soldiers being laden with 60 lbs. weight of accoutrements, §§ we have a full estimate of labour work. This is found by the following equation:—

$$\left[ \frac{150 + 60}{20} \right] \times 73920 = 776160 \text{ foot-pounds.}$$

The weight of the man and of his accoutrements, divided by the co-efficient of traction, and multiplied by the number of feet traversed, thus leads us to a result rather less than that found for the pedestrian. The following table gives the dietetic value for soldiers engaged in the arduous duties of war:—

Table III.—Dietaries of Soldiers during War.—Mean of European and American Diets during recent Wars.

	oz.
Weight of solid food . . . . .	46.0
Flesh-formers . . . . .	5.41
Fat . . . . .	2.41
Starch, sugar, &c. . . . .	17.92
Starch equivalent . . . . .	23.48
Mineral matter . . . . .	0.68
C Carbon in flesh-formers . . . . .	2.90
C' Carbon in heat-givers . . . . .	9.81
Total carbon, C + C' . . . . .	12.71
Ratio C : C' :: 1 x . . . . .	3.37
Ratio of flesh-formers to starch equivalent . . . . .	4.35

Hence it will be observed that about 5.5 oz. of flesh-formers, and  $23\frac{1}{2}$  oz. of the starch equivalent of heat-givers, are required by the soldier to enable him to withstand the fatigues of war.

10. We possess in the English army a corps of soldiers who are labourers even during peace. I allude to the Royal Engineers, who, while in the depôt at Chatham, are actively occupied either in constructing field works, or in pursuing their avocations as artisans, from which class they are all selected. Desirous to obtain the dietaries of these men, I applied to Colonel Collinson, R.E., the second in command at Chatham, and he, with the consent of Colonel Harness, instituted a careful inquiry into the actual amount of food consumed by 495 men for twelve consecutive days. Quartermaster Conolly took an active part in the inquiry, and the captains of each of the companies became responsible for the accuracy of the returns, which were made with all the detail and care to be expected from this highly scientific corps. These returns were then reduced to their dietetic value by myself, so that we may consider them as affording the most complete evidence which we possess of the requirements of food for labouring men during a fair but not an excessive amount of work in twenty-four hours.

Table IV.—Dietaries of the Royal Engineers from 1st to 12th January, 1865.

	Mean of all returns.
Number of men giving returns . . . . .	495
Weight of solid food . . . . .	oz. 66.97
Flesh-formers . . . . .	" 5.08
Fat . . . . .	" 2.91
Starch, sugar, etc. . . . .	" 22.22
Starch equivalent . . . . .	" 29.38
Mineral matter . . . . .	" 0.93
C carbon in flesh-formers . . . . .	" 2.730
C' carbon in heat-givers . . . . .	" 12.113
Total carbon, C + C' . . . . .	" 14.844
Ratio C : C' :: 1 x . . . . .	" 4.45
Ratio of flesh-formers to starch equivalent . . . . .	" 5.82

There are several points of interest shown by these reductions. The working soldier finds it necessary to take about five oz. of flesh-formers daily. The only notable exception is in the case of a detachment of the 38th Company, stationed at the South Kensington Museum. This exception furnishes a ready explanation, for although these soldiers are even better paid than those at Chatham, their work is of a less laborious character, being chiefly that of draughtsmen, photographers, etc.; with this work they do not require a larger quantity of flesh-formers than is consumed by soldiers of the line, and accordingly we find that their diet sinks to this level. ||| Omitting this exceptional case, we find a singular uniformity in the starch equivalent of heat-givers. It is higher than that of soldiers engaged in war, but this is doubtless due to the ease with which potatoes are obtained in garrison, and to their being always in considerable quantity in the diet.

11. We do not possess many well-recorded instances of labourers' diets by actual weight and measure. The approximative returns obtained by Dr. E. Smith, in his report to the Privy Council on the diet of the working classes, are valuable for what they profess to be, as giving us an insight into the mode of living of artisans; but they can scarcely be considered as presenting us with data of weight and measure, ascertained with any further degree of precision than could be obtained by conversation with working people. I append a few instances of working dietaries, which have been determined by actual weights of the food consumed.

||| For this return I am indebted to Captain Donnelly, R.E., Inspector of Science to the Department of Science and Art.

†† Haughton on a New Theory of Muscular Action, p. 16.

‡‡ Rankine, "Applied Mechanics," p. 610.

§§ Parkes, "Hygiene, p. 369.



Table V.—Examples of Labourers' Diets.

Class of Labourer.	Flesh-formers	Fat.	Starch, sugar, &c.	Starch equivalent.	Carbon.
English sailor (fresh meat)¶¶.	5.00	2.57	14.39	20.40	11.05
French sailor*.	5.74	1.32	23.50	26.70	14.58
English navy (Crimea)†.	5.73	3.27	13.21	21.06	11.46
" " (Rouen Railway)‡.	6.84	3.82	27.81	37.08	18.96
Hard-worked weavers§.	5.33	1.53	21.89	25.42	13.76
Fully-fed tailors  .	4.63	1.37	18.47	21.64	11.74
Blacksmiths¶¶.	6.20	2.50	23.50	29.50	15.69
Mean working diet.	5.64	2.34	20.41	25.97	13.89

I have not quoted in this table the well-known allowances of 910 lbs. oatmeal given annually to our Scotch agricultural labourers on the bothy system, and 60 oz. of milk daily. This diet equals  $8\frac{3}{4}$  oz. of flesh-formers, 4.5 oz. of fat, and nearly  $27\frac{1}{2}$  oz. starch. I attach little importance to this, because it is well known that the labourer sells nearly a quarter of the oatmeal to buy spirits and other luxuries. A man training for prize-fighting,\*\* and who walked seventeen miles daily for exercise, was found to eat weekly 269 oz. of mutton, without bones, 14 oz. of bread (only 2 oz. daily at dinner), and 170 oz. of ale. The food of this prize-fighter had therefore the following dietetic value:—

Flesh-formers	. . . . .	9.8 oz.
Fat	. . . . .	3.1 "
Starch	. . . . .	3.27 "
Starch equivalent.	. . . . .	10.70 "

This result, however, is certainly not an average case, although interesting as showing the conditions employed in training a man to the extreme of muscular activity.

12. From the preceding data we propose to take the following general averages in our calculations:—

	Subsistence Diet.	Diet in Quietude.	Diet of Adult in full Health.	Diet of Active Labourers.	Diet of Hard-worked Labourers.
	oz.	oz.	oz.	oz.	oz.
Flesh-formers	2.0	2.5	4.2	5.5	6.5
Fat	0.5	1.0	1.8	2.5	2.5
Starch	12.0	12.0	18.7	20.0	20.0
Starch equivalent	13.2	14.4	22.0	26.0	26.0
Carbon	6.7	7.4	11.9	13.7	14.3

(To be continued.)

## ACADEMY OF SCIENCES.

May 1, 1865.

M. SEGUIER made some further remarks "On Improvements in Firearms," and showed an experiment which illustrated the effects of a sudden application of force on glass. (This experiment is described by our Paris correspondent.)

M. Boussingault read a memoir "On the Functions of Leaves." The author has made some further experiments on the absorption and assimilation of carbonic acid by leaves exposed to sunlight. His results are thus summed up:—

1. Leaves exposed to the sun in pure carbonic acid do not decompose this gas, or if they do, it is with excessive slowness. 2. Leaves exposed in a mixture of carbonic acid and atmospheric air rapidly decompose the former gas. Oxygen does not seem to interfere in the phenomenon. 3. Carbonic acid is rapidly decomposed by leaves

when that gas is mixed with either hydrogen or nitrogen. The author points out some analogies of these phenomena with the slow combustion of phosphorus under certain circumstances. Thus phosphorus placed in pure oxygen does not become luminous and does not burn, or if it does, burns with excessive slowness. In a mixture of oxygen and atmospheric air, however, phosphorus burns rapidly. Further, phosphorus placed in a mixture of oxygen with hydrogen, nitrogen, or carbonic acid burns and emits light. M. Boussingault mentioned also that phosphorus which does not burn in pure oxygen at an ordinary pressure, becomes combustible when the gas is rarefied, and he showed that similarly a leaf placed in pure and rarified carbonic acid decomposed the gas and evolved oxygen.

M. Pelouze read a memoir "On the Volumetric Determination of Iron in the Blood." The author takes a given weight of blood, dries it carefully, incinerates the residue, dissolves the ash in hydrochloric acid, and then estimates the iron by Margueritte's process. He gives a table of the amount of iron in 100 grammes of the blood of various animals, and states by way of summary that, if he is not deceived, there is in 1000 parts of the blood of birds from 3 to 4 parts of iron, and in the blood of mammals from 5 to 6 parts.

M. H. St. Claire Deville presented a memoir "On the Phenomena of Dissociation in Homogeneous Flames." It related to the chemical composition and the distribution of heat in a flame produced by a mixture of oxygen and hydrogen, or carbonic oxide and oxygen burnt from an oxy-hydrogen blow-pipe. The author in this paper describes the results with carbonic oxide and oxygen, mixed in the proportions to form carbonic acid. The flame is seen to be composed of an outer and inner cone; the latter composed of the uncombined gases, the former of the gases in combustion. The interior cone had a height of about 10 millimetres, while the more visible part of the exterior cone rose to 70 or 100 millimetres. We may, on a future occasion, translate the description given by the author of the means which he used to withdraw the gases from different parts of the jet of flames, and also a table showing the temperature and the composition of the gas at various heights; to-day we must content ourselves with the following summary. The observations show,—

1. That the temperature goes on increasing from the lower part of the flame up to the summit of the interior cone.

2. That the proportion of uncombined gases (oxygen and carbonic oxide) to the combined gas (carbonic acid) increases from the upper part of the dart of flame, where carbonic acid alone was found, down to the lower part (summit of interior cone) where only two-thirds of the oxygen and carbonic oxide had united.

M. de Vergnette-Lamotte made a communication "On the Effects of Heat in the Preservation and Improvement of Wines." Burgundy is much improved by a voyage to and from Calcutta. This fact led the author to try the effects of warmth on wines at home, and both he and M. Pasteur have come to the conclusion that wines may be much improved by gently warming them, and that sick wines may be cured by the same means. M. Pasteur has, in fact, taken out a patent for warming wines by placing the bottles in a hot-air stove with the corks tied down to prevent their being forced out by the expansion. The bottles must be quite full, and have no air in them, and are heated to 64° C. for half-an-hour, after which the cork is untied, driven home, and sealed down. In the process just described of course all parasitic ferments are destroyed, and the wines keep well after it.

Admiral Berigny presented a memoir entitled "A Résumé of Ozonometric Observations for Nine Years." The experiments were made at Versailles, and the results arrived agree exactly with those M. Houzeau observed at Rouen. (See ante, p. 201.) The maximum of ozone is observed in May, the minimum in November and February. M.

¶¶ Advantages of Entering British Navy. Bradbury and Evans, 1854.

\* Payen, Substances Alimentaires, p. 322.

† Dietary to Navvies Employed in Making the Railroad in the Crimea (Letheby), Soc. Arts Journ., 1863.

‡ Gasparin, Cours d'Agriculture.

§ Dr. E. Smith, Phil. Trans., vol. 151, p. 747, et seq.

|| Idem.

¶ Food consumed by a blacksmith; mean of two days.

\*\* Percy on Fæces.

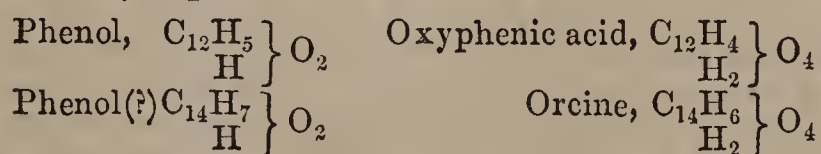


Deville remarked the coincidence of the phenomena with the passage of asteroids. M. Elie de Beaumont remarked the coincidence of the maximum of ozone with the maximum activity of vegetable synthesis, while the minimum coincided with the maximum activity of vegetable decomposition. Surrounded by forests, the town of Versailles is well placed for observing this double influence.

M. Hugo Schiff presented a note "On Some Amides of the Toluic Series," obtained by the action of various aldehydes upon toluidine and tolulylendiamine.

M. Pisani described a mineral found under a dead tree at Chypis, and composed of bicarbonate of potash, which the author proposes to call *Kalicine*.

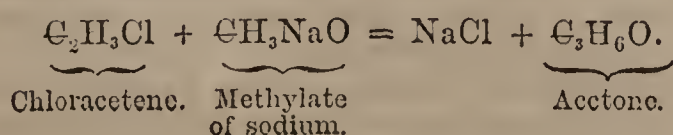
M. V. de Luynes gave a continuation of his "Researches on Orcine." The author described diacetic, dibutyric, and dibenzoic orcine. It results from the author's researches that orcine is found to behave towards acids and bases like phenic acid; but while phenic acid in contact with acid chlorides only exchanges one equivalent of hydrogen for one equivalent of the chloride of the radical, orcine, under the same circumstances, exchanges two of hydrogen for two of the chloride. Hence, if phenic acid be considered a monatomic phenol, orcine must be classed among the diatomic phenols. By its formula orcine is the homologue of oxyphenic acid,  $C_{12}H_6O_4$ , which gives with acid chlorides biacid compounds; it is derived from oxysalicylic acid in the same way as phenol from salicylic acid. Oxyphenic acid, then, is the diatomic phenol corresponding to phenic acid. So orcine is the diatomic phenol corresponding to the monatomic phenol  $C_{14}H_8O_2$ , identical or isomeric with cresylic phenol as shown here:—



An attentive study of these phenols may show in what way their synthesis must be attempted.

M. Harnitz-Harnitzky communicated "A General Method of Synthesis of Volatile Fatty Acids." Mitscherlich showed that acids of the fatty and aromatic series, under the influence of caustic alkalis, and at a high temperature, split up into carbonic acid and carbides of hydrogen containing an atom of carbon less, and as much hydrogen as the acids employed. He therefore regarded these bodies as carbonates of carbides of hydrogen. Last year the author fixed carbonic acid on benzene, and so obtained benzoic acid. He has now added carbonic acid to marsh gas, and formed acetic acid, and also to hydride of amyl, and so formed caproic acid. He makes use of oxychloride of carbon as the source of carbonic acid. Oxychloride of carbon and marsh gas brought together in a retort heated to  $120^\circ$  combine to give chloride of acetyl and hydrochloric acid. The former, on the addition of water, furnishes acetic and hydrochloric acids. In the same way hydride of amyl and oxychloride of carbon furnish hydrochloric acid and chloride of caproyl. The substance which condenses in the receiver is an oily liquid which the author rectifies, and taking the part which distils between  $115^\circ$  and  $140^\circ$ , treats it with absolute alcohol, so as to obtain caproate of ethyl. Another distillation, collecting between  $161^\circ$  and  $163^\circ$  gives a liquid lighter than water, possessing the aromatic odour of caproic ether. In both cases the author confirmed his results by analyses.

M. C. Friedel communicated "A New Method of Producing Acetone by Synthesis." The author started with chloracetene (a body first obtained by Harnitzky by the action of oxychloride of carbon on aldehyd), and added this to methylate of sodium, whereby chloride of sodium and acetone were formed.



M. Persoz presented a note "On the Decomposition of Ammonic Nitrate by Heat." M. Pelouze objected to the author's former experiment (see *ante*, p. 166) that nitrate of ammonia is volatilised by heat, and its decomposition might furnish the nitric acid found with the potash lime. M. Persoz has, therefore, experimented further, and finds that the nitrate distils, and is, moreover, decomposed in the process, for it condenses along with a strongly acid liquid. By repeating his former experiment, however, with a plug of moist cotton in the neck of the retort to arrest any nitrate of ammonia or other condensable product, he obtained the same results as before—potassic-nitrate and ammonia. Persoz admits the truth of Pelouze's statement that when the protoxide of nitrogen is washed with dilute sulphuric acid no ammonia is obtained, but only nitric acid.

## NOTICES OF BOOKS.

*Bulletin Mensuel de la Société Chimique de Paris*, &c.  
April, 1865.

WE transcribe the titles of the papers read before the Chemical Society of Paris, which have not already been noticed in our reports of the Academy of Sciences. "On hydriodate of bromated ethylene, and on its decomposition by hydrated oxide of silver and acetate of silver," by Pfaundler. "On diamido-salicylic acid, and its combinations with acids," by Saytzeff. "On the action of bromine on isopropyl alcohol, and on iodide of isopropyl," by Friedel. "Researches on the nitrated naphthalines, and bases derived from them," by A. d'Aguiar. "Facts relating to the chemical metamorphoses of santonine," by Sestini. And "On the absorption of iodine by urine and other animal fluids," by Terreil. In this last paper the author shows, in reply to Schönbein, that urate of ammonia is the substance which effects the absorption of urine in animal fluids, and he employs iodine to determine the amount of urate, calculating that one equivalent of each body unites in the reaction. He uses the iodine in a standard alcoholic solution, containing 12.86 grammes in the litre.

*Chemisches Central-Blatt*. No. 13.

NUMBER 13 contains several papers on organic chemistry, which have already received notice in our pages. Some short paragraphs "On the Reciprocal Hygroscopicity of Chloride of Calcium and Sulphuric Acid," "On the Use of Aniline Colours in Oil and Aquarelle Painting, and "On a Means of Combining Aniline Red with Oils and Fats," will be found among our "Miscellanea."

Number 14 contains the conclusion of an article by Arppe, "On some Products of the Oxidation of Fat," In the former paper the author described sebatic and azelaic acids and some of their salts. He now describes suberic, pimelic, adipic, lipic, nitrocapric, and nitrocaprylic acids. The rest of the papers have been noticed in connection with other journals.

All the articles in Numbers 15 and 16 are abstracts of articles on advanced organic chemistry, and would have no interest for the great bulk of our readers.

Number 17 contains an original article by Bunge "On the Action of Sodium Amalgam on some Metallic Salts." A tolerable strong aqueous solution of ferric chloride, acidulated with hydrochloric acid, when treated with sodium amalgam becomes clearer and clearer, and at last colourless, the whole of the iron being reduced to protoxide. By the further action of the amalgam all the iron is withdrawn from the fluid, and is found as iron amalgam. The author is of opinion that the reduction of ferric to ferrous chloride, and of the latter to metallic iron, proceeds simultaneously.

Chromic chloride suspended in acidulated water undergoes a similar reduction. The amalgam of chromium



was fluid, and rather unstable. On standing its surface became covered with a dark grey powder of metallic chromium.

Mercuric and gold chlorides are similarly reduced. In the former case calomel is first produced.

The chloride, iodide, and bromide of silver are very quickly reduced. (The author made all these experiments in the dark.) This reaction, it is thought, may be usefully applied in the analysis of the haloid compounds of silver, instead of fusing these compounds off with an alkaline carbonate. It is only necessary to place a small quantity of the powder in a test glass with a little water, and add thereto some pieces of sodium amalgam, and the chlorine, iodine, or bromine may be detected in the solution in the ordinary way.

The next paper is the first part of an abstract of Stas' report "*On the Commercial Methods of Extracting the Fatty Acids.*" The original paper, our readers know, is of great interest.

"*A Contribution to the Chemistry of Clays,*" by E. von Sommaruga, follows. The author is analyst to the Vienna porcelain works, and gives here several analyses of German clays and felspars with special instructions respecting their use in the manufacture of porcelain.

*Zeitschrift für Chemie, &c.* Nos. 5 and 6, 1865.

THIS journal in all but the form now resembles the *Central-Blatt*. In No. 5 we find no original communication; No. 6 contains one, "*A Preliminary Notice of Cytisin and Laburnin,*" two new bases found in *Cytisus Laburnum* by Huseman and Marmé. Cytisin is a strongly poisonous alkaloid, which the authors have extracted from the ripe seeds of the laburnum, and have also been found in three other species of the family *Cytisus*. To obtain the alkaloid the authors precipitated a decoction of the seeds with acetate of lead, concentrated the filtrate, and precipitated with tannic acid. This precipitate was decomposed by digesting and evaporating to dryness with oxide of lead, and from the dry mass alcohol extracted the alkaloid. Pure cytisin forms a colourless crystalline mass; is strongly alkaline; sublimes undecomposed, and quickly liquefies in the air. The nitrate crystallises well, and the alkaloid was purified by converting it into this salt, evaporating the solution with oxide of lead, and extracting with absolute alcohol.

*Laburnin* is a weakly basic poisonous body, which the authors procured from the unripe seeds and pods of the laburnum. It is obtained by a process similar to the above, but in place of tannic acid, phosphomolybdate of soda was used to precipitate the alkaloid, and the precipitate was decomposed by boiling to dryness with chalk; absolute alcohol extracted laburnin from the dry residue. The authors promise further communications on these bodies.

*Journal für Praktische Chemie.* No. 2, 1865.

THIS journal opens with a long paper by Hlasiwetz, and Pfaundler "*On Morin, Machurin, and Quercitrin.*" The account of these vegetable principles and their derivatives in this and former papers by the same authors is very complete.

In a short chemical notice by F. Stolba, of Prague, he announces the detection of *copper in beer*, a likely thing to find in all beers. The process recommended by the author for detecting the metal is as follows:—He dips a strip of filter paper in the beer and dries it, and repeats this operation four or five times. He then wraps the paper round a piece of iron wire and ignites it. The ash so obtained he mixes with a very small quantity of pure sal ammoniac and water to form a thick paste, and on the end of the wire introduces it to the outer flame of a spirit lamp. The least trace of copper colours the flame blue. The analyser must of course assure himself that neither

the paper nor the sal ammoniac contains copper, and must not use a brass lamp.

The same author gives a "*Contribution to the Knowledge of Lead.*" He first shows that the red-coloured lead supposed by Wöhler to be an allotropic condition of the metal, is only lead covered with an exceedingly thin layer of some foreign matter, probably oxide. The author has made numerous experiments "*On the Action of Pure Water on Lead,*" and states that when pure distilled water is boiled with a somewhat large quantity of foil or granulated lead, a very appreciable amount of hydrogen is evolved. The conditions under which this experiment can be made will be apparent to our readers. In ten minutes two cubic centimetres of hydrogen were obtained.

The fluid remaining in the flask was strongly alkaline, and cloudy with lead oxide.

In text-books it is said that lead is but slightly attacked by hydrochloric acid, and only when heated. Stolba, however, states that hydrogen is evolved from the mixture at the ordinary temperature, and on the application of heat the action becomes energetic when finely granulated lead is employed. By contact with copper the evolution of hydrogen is greatly increased. The author notices that the action of hydrochloric acid is strongest at first, and gradually becomes weaker in consequence of the metal becoming coated with a layer of chloride.

Dr. C. Rube, of Freiburg, communicates "*A Method of Estimating Magnesia and the Alkalies.*" He takes the mixed sulphates, and after ignition and weighing dissolves them in a small quantity of water, and then first precipitates the potash with chloride of platinum. He then removes the excess of platinum from the filtrate by sal ammoniac, and afterwards precipitates the magnesia from this filtrate by phosphate of soda. After standing some hours, the solution filters easily, and the magnesian precipitate can be collected and weighed. The soda is obtained by difference.

Among the short notices we only find one which has not already appeared in our pages, and that one, "*On a Yellow Colouring Matter from Rosaniline,*" will be found in another place.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

538. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, "Certain improvements in the treatment of madder and the products obtained therefrom."—A communication from J. Pernod, Avignon, France.—Petition recorded Feb. 25, 1865.

872. W. Walsh, Warrington, "Improvements in apparatus employed in the concentration of all solutions where quick or speedy concentration or evaporation is required."—March 28, 1865.

942. H. Brook, J. Eastwood, and G. Brook, Huddersfield, "Improvements in apparatus applicable to furnaces for smelting ores and melting metals."—April 3, 1865.

1068. W. Clark, Chancery Lane, "Improvements in the manufacture of a compound or material to be used as a substitute for india-rubber."—A communication from H. Loewenberg, New York, and E. Grainer, Paris.—April 15, 1865.

1076. J. Dougan, Coed Ta'on, near Mold, North Wales, "Improvements in apparatus for distilling hydrocarbons from coal, schists, and other minerals."—April 17, 1865.

1088. R. A. Jones and Joseph Hedges, Aylesbury, "Improvements in, and apparatus for, communicating intelligence by means of electricity."—April 19, 1865.

1149. N. Sibly, St. Laurence, near Bodmin, Cornwall, "Improved apparatus for pouring and decanting liquids."



1153. J. N. Brown, Handsworth, and T. D. Clare, Birmingham, "Improvements in the manufacture of iron, and in preparing fuel to be used in the manufacture and melting of iron."

1159. J. C. Wiekham and A. E. Deiss, Bow, "Improvements in the manufacture of waterproof fabrics, and in apparatus to be employed therein."—April 25, 1865.

NOTICES TO PROCEED.

3192. J. Bethell, King William Street, London, "Improvements in preserving wood."—Petition recorded Dec. 23, 1864.

3214. H. Hicklin, Wollaston, near Stourbridge, and C. Pardoe, Brierly Hill, "Improvements in the construction of coke ovens."—Dec. 27, 1864.

3242. B. Baugh, Balsall Heath, "New or improved machinery to be used in the manufacture of enamelled wares."—Dec. 29, 1864.

596. W. R. Bowditch, Wakefield, "An improvement in carburetting gas, and improved methods of treating alkali which has been used to purify coal oils, shale oils, petroleum, and other mineral oils."—March 3, 1865.

CORRESPONDENCE.

Continental Science.

PARIS, May 9.

A NEW hygrometer has recently been invented, which, it is said, gives very correct indications. It consists of a thin circular slice of ivory sawn into a spiral, which being extended, by its contractions and expansions gives motion to an arm. I doubt whether this apparatus is more sensitive than the old twisted catgut form of weather indicator.

M. Pelon's "heat generator," which I mentioned last week, is in actual use at the Central Pharmacie, and seems to be really efficacious. The machine is turned by a force equal only to about the twentieth of a horse-power, but after rotating for about eight or ten minutes the air escaping from the apparatus was found to have attained a temperature of  $70^{\circ}$  C. An apparatus of a similar size, moved by the same force, it is said, will, in the coldest winter, keep a railway-carriage at a constant temperature of  $22^{\circ}$  to  $25^{\circ}$  C., which will be a great comfort to the passengers.

On the 21st of last month the Photographic Society of Paris awarded four gold medals. One of these was allotted to Sir David Brewster for the invention of his stereoscope. The Abbé Moigno wonders why the Society did not go back further, and give a medal to Professor Wheatstone for his stereoscope.

The recent edict of the Minister of Agriculture and Commerce, ordering manufacturers using steam power to consume their smoke, has excited much opposition. There are plenty of inventions here as well as in London for effecting this purpose, but they do not seem to answer any better here than with you. The Industrial Society of Mulhouse have sent a petition to the Minister, asking for a suspension of the edict for six months, that the question may be seriously studied. They say that none of the inventions yet brought out are satisfactory in practice. They either necessitate an increased consumption of coal or they require greater attention on the part of the stoker than can possibly be given in actual practice. The inventors, of course, deny the truth of these assertions, and thus the matter at present remains. There would seem to be a field for Mr. Jukes, whose apparatus I have seen to answer perfectly in London, and to require very little attention by the stoker.

I mentioned M. Seguer's new eartridg last week, and, writing in a hurry, did not, I am afraid, give a very clear account of his ideas. I should have said that the best application of the force which is produced by the conversion of solid into gaseous matter is made when that force is, so to

speak, generated *crescendo*. This the Baron effects by first igniting a slow burning powder, which starts the ball, and firing afterwards a charge of gun-cotton, which gives a tremendous impulse, thus imitating the action of an air-gun. The Emperor has taken great interest in the Baron's experiments and invention. Emperors usually do take great interest in destructive arts. The Baron appeared again at the last meeting of the Academy, and exhibited a curious and very interesting experiment.

Your readers will remember Faraday's old experiment of smashing a glass vial by breaking a Prince Rupert's drop within it immersed in water. The experiment of Baron Sequier is of a similar kind, and illustrates the same fact—namely, the incompressibility of water. He took a glass tube, and suspended it vertically in a vessel of water. He then let a leaden bullet fall through the tube, the effect of which was to split the tube into longitudinal fragments, like the staves of a barrel. When only a part of the tube is immersed, the effect is more curious still. That part not immersed remains entire, but the tube is cut off at the level of the water, and the part under the water is split, as before mentioned. Any of your readers can make these experiments for themselves.

General Morin made some remarks on this subject, and mentioned some experiments made several years ago, in which solid and hollow shot were fired into water horizontally below and parallel to the surface of the water. The resistance of the water was found to be so great that the shells were in all cases broken to pieces. The earthwork of the tank, four metres thick, was always strongly shaken, and the experimenters felt the ground tremble under their feet.

MISCELLANEOUS.

**The Royal Society's Soiree.**—As President of the Royal Society, Major-General Sabine held his second reception on Saturday evening last, 6th inst., at Burlington House. Although the assembly was not graced by the presence of royalty, as on the former occasion, there was a full attendance of visitors, and a very numerous and interesting collection of objects exhibited. The fine arts were well represented by some choice original drawings by Corregio and other old masters from the Queen's collection; by the paintings of Mr. M'Callum and M. Van Haanen; and by the sculpture and wood-carvings of Messrs. Durham, Munro, Boehm, Woolner, and Rogers. Mr. Joubert sent some of his best photo-enamels, and M. Claudet, Messrs. M'Lean and Haes, and Mr. Swan, some excellent examples of photography, each in their particular and characteristic style. Among the scientific instruments were shown Dr. Sprengel's air-pump, and a very delicate thermo-electric apparatus, for showing the development of heat during the growth of plants, by Messrs. Elliott, Brothers. Mr. Gassiot's new rigid spectroscope, wherein the prisms are made to perform double work, and all the essential parts are mounted permanently. Mr. J. Browning showed some novel and very pretty effects suggestive of the kaleidoscope by means of a new revolving spectroscope with perforated diaphragms and prisms kept in rotation; other spectrum instruments for adaptation to the microscope and for a variety of particular applications were likewise exhibited by Mr. Browning. Messrs. C. and F. Daker exhibited some of the beautiful polarising objects for which their house has long been celebrated; amongst these a bunch of grapes and attached vine leaves was remarkable for the care bestowed in its production. The magnificent series of iron and steel specimens shown under the microscope by the aid of Mr. Sorby's special illuminator, appeared to excite much interest, as also a large block of meteoric iron with accompanying photographic representation of the etched surface, sent by Professor Abel. A very fine specimen of the new mineral,



langite, was shown by Mr. J. R. Gregory; and Messrs. Johnson and Matthey sent some splendid illustrations of the platinum, gold, and magnesium manufactures. The Society's meeting-room was throughout the evening subjected to alternate illumination by the magnesium light, and by flashes from Captain Colomb's signaling apparatus.

**Metalliferous Mines Bill.**—In the House of Commons on Monday last, Mr. Kinnaird asked the Secretary of State for the Home Department what steps he had taken, or proposed to take, to remedy the very serious evils which had been brought to light by the evidence taken by the Royal Commission appointed to inquire into the condition of mines, and which reported last session. Sir G. Grey said that the course which had been taken with respect to the report was this:—It had been thought right to confer with the members of that Commission, several of whom were members of the House, on the subject. On many of the points raised in the report it did not appear possible that any legislation could take place, but there were other points on which it might be expedient to legislate, and he had accordingly called a meeting at the Home Office, when that matter was fully gone into; and it was decided by a majority of the members of that Commission that with a view to the accomplishment of the object in question it was inexpedient that any hasty legislation should take place. It was necessary that the recommendation of the Commissioners, with respect to the county of Cornwall especially, should be more thoroughly discussed and the opinions of persons interested in mines in the locality should be obtained. That opinion, however, was not shared by his noble friend at the head of the Commission, who had proposed to introduce a bill with a distinct object, but for the reasons he had stated the Government did not think it desirable to introduce any bill during the present session.

**Magnesium.**—Mr. J. N. Hearder, of Plymouth, in experimenting with this new metal has discovered some explosive compounds of tremendous power and striking peculiarities. He ignited a small portion (about twenty grains) of one of these compounds during a lecture which he gave at the Plymouth Mechanics' Institute, the instantaneous and dazzling effect of which upon the audience was like that of a flash of lightning, causing the room to appear for some seconds afterwards to be enveloped in darkness, though it was at the time brilliantly lighted with gas. On causing two bars of magnesium to form the terminals of a powerful voltaic battery, which was prepared to exhibit the electric light, a most intense combustion ensued, one of the bars speedily became red-hot, entered into ebullition, and then burnt spontaneously so furiously that it became necessary to plunge it into water to prevent its falling on the platform. In this process portions of the burning metal detached themselves, and floated blazing on the surface of the water, decomposing it after the manner of potassium, and liberating hydrogen, which also burned. The experiment had never been tried before, and the result possesses much scientific interest.—*Mining Journal*.

**Royal Institution of Great Britain.**—General monthly meeting, Monday, May 8, 1865; Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., President, in the chair. The President appointed the following Vice-Presidents for the ensuing year:—The Lord Wensleydale, the Earl Percy, Sir R. J. Murchison, and Wm. Pole, Esq. Charles Butler, Esq., William Henty, Esq., Walter Morrison, Esq., M.P., George Banks Rennie, Esq., Arthur Charles Tanqueray, Esq., and Philip D. Tuckett, Esq., F.G.S., were elected members of the Royal Institution. The following Professors were re-elected:—William Thomas Brande, Esq., D.C.L., F.R.S., Hon. Professor of Chemistry; John Tyndall, Esq., Ph.D., F.R.S., Professor of Natural Philosophy; Edward Frankland, Esq., Ph.D., F.R.S., Professor of Chemistry. The special thanks of the members were

returned for the following additions to "The Donation Fund for the Promotion of Experimental Researches:"—John Carrick Moore, Esq. (2nd annual donation), 10l.; Harry Mackenzie, Esq. (2nd donation), 20l. The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same. The following are the arrangements for the ensuing week:—Tuesday, May 16, at 4 o'clock, Prof. Frankland, "On Organic Chemistry." Thursday, May 18, at 4 o'clock, Prof. Frankland, "On Organic Chemistry." Friday, May 19, at 8 o'clock, Wm. Huggins, Esq., "On Stellar Physics and Chemistry." Saturday, May 20, at 4 o'clock, Alexander S. Herschel, Esq., "On Meteorology."

**Silicate of Methyl and Silicium Methyl.**—Friedel and Crafts have announced to the Paris Chemical Society that they have succeeded in forming silicate of methyl by the action of perfectly pure and dry wood spirit on chloride of silicium. By heating together zinc methyl and chloride of silicium they obtained silicium methyl.

**Action of Petroleum on the Human System.**—Landerer relates the case of a man who swallowed a quantity of petroleum, the greater part he vomited again. It caused a strong burning sensation in the tongue and throat, which were reddened and became swollen. The stomach and bowels were also affected, and slight gastro-enteritis ensued. For several days the urine and sweat smelt strongly of the oils, and the odour was specially strong under the arm-pits. The patient was very weak for a time, but recovered.—*Chem. Central Blatt*.

**How to Combine Fat and Oil with Aniline Red.**—Dr. E. Jacobsen gives the following process:—He first separates rosaniline from commercial fuchsine by heating with soda or digestion with ammonia, washes and dries it. He then adds the rosaniline to oleic acid or melted stearic acid as long as it will dissolve, or puts them together in equivalent proportions. An excess of oleic acid must be avoided when the compound is required for a varnish, as it delays the drying. Oleate or stearate of rosaniline easily dissolves in fats or oils, and colours these an intense red. If it is wanted for a linseed oil varnish, the linseed oil must be free from lead. The compound must be kept from the fire, or it soon burns blue, probably by the reducing action of the fatty acids. The best red colour is obtained in linseed oil varnish. Stearin with oleate or stearate of rosaniline appears a bluish red. Paraffin appears to act as a reducing agent with the compounds of fatty acids and aniline, and changes to a dirty violet colour; the mixture then is inapplicable to the colouring of paraffin or stearine candles. The oleate or stearate of rosaniline is a good colouring agent for hair oil or pomatum, but from the instability of the colour seems inapplicable for oil painting or varnishes.—*Dingler's Polytech. Journ.*, Bd. 174, S. 405.

## ANSWERS TO CORRESPONDENTS.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Q. Q. (or 99).—Received, with thanks. The writer's industry is commendable, and his acuteness remarkable. He may be assisted out of the last difficulty by remembering that in this formula  $O=100$ .

Books Received.—"A Letter to the Members of the British Medical Association," &c., by R. B. Carter, F.R.C.S.; "Notes on Chemistry," &c., by Dr. Bernays.



## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*On the Influence of Ozone and some other Chemical Agents on Germination and Vegetation, by M. CAREY LEA, Philadelphia.*

AT no time has the subject of the influences of chemical agents on plants received so much intelligent attention as at present, and the labours of Boussingault, Knop, Stohmann, Ville, Sachs, and many others are daily adding to our stock of knowledge and developing new and interesting facts. The studies of these chemists have, however, been directed almost entirely to the effects of the absence or presence in greater or less proportion in the soil of those bases and acids which are there commonly found. With respect to other agencies, little has been done since the valuable investigations of Turner and Christison, made more than thirty years ago, in which they examined the effects of chlorhydric and nitrous acid gases, chlorine, sulphuretted hydrogen, cyanogen, and some other gases. Göppert about the same time published some investigations upon the influence of cyanhydric acid. The effect of all these substances was very much what might have been anticipated from their tendency to attack organic tissues.

The examinations which I propose here to describe have been made in a somewhat different direction. The most curious result obtained appears to me to be that relating to the effect of a highly ozonised atmosphere upon the roots of plants. I have also found that organic substances not in the least corrosive, and even entirely neutral, may exercise a powerfully poisonous influence upon vegetation, when disseminated in the atmosphere surrounding it.

**1. Influence of Ozone.**—The ozone used in the following experiments was generated by the action of sulphuric acid upon chameleon mineral. Two or three grains of chameleon mineral were placed in a small capsule and moistened with oil of vitriol. This, when placed by itself, or with a vessel of water under a bell-glass of about three litres capacity, was found to maintain a highly ozonised atmosphere for five or six days, or even longer. But as the presence of vegetation would tend to destroy the ozone rapidly, it was considered expedient to renew the generating mixture every two or three days. In all cases the capsule was placed aside for half an hour or more to allow the red vapours to be thoroughly dissipated before introducing it beneath the bell-glass.

Two sets of experiments were made: in the first, the water with which the seeds came in contact was made to contain those solid substances which are most essential to vegetation. In the second, very pure river water was used. For the first, phosphate of soda, silicate of potash, sulphate of magnesia, nitrate of lime, and sesquichloride of iron were added to water in a proportion such as to be equivalent to three-tenths of 1 per cent. of solid matter. In order to afford a just term of comparison, two vessels every way similar were filled with this prepared water, were covered with gauze so that the gauze should rest on the surface of the water, and were placed under bell-glasses resting on glass plates. Wheat and maize grains were placed on the gauze, and beneath one bell-glass was introduced the ozone-generating mixture.

2nd day.—Germination appeared to be more advanced in the vessel containing the ozone. Seeds, however, of like origin, and exposed to the same influences, germi-

nate so irregularly that much importance is not to be ascribed to this.

3rd day.—The seeds in ordinary air had overtaken the others. They were already covered with mould, of which no sign appeared on those exposed to ozone.

4th day.—Mouldiness much increased in the one, still none in the other. The rootlets of the plants exposed to ozone begin to exhibit remarkable effects, extending themselves upwards instead of downwards, and becoming pinkish at the extremities.

5th day.—Ozone plants much behind.

8th day.—The disposition of the roots of the plants exposed to ozone to grow upward still continues. Of the wheat plants, fully one-half the rootlets have shot directly into the air. The only maize plant which has as yet germinated has sent up a healthy plumula over one inch in length; its three rootlets are all directed upward and away from the water. Nothing in the least similar has taken place in any of the seeds not exposed to the influence of the ozone.

12th day.—The experiment was terminated. The average height of the wheat plants not exposed to the ozone was ten inches; of those exposed, four inches. The effect of the ozone in checking the growth of the roots was very remarkable, especially with the wheat plants. In those not exposed to ozone, the roots attained a length equal to about one-fourth the height of the stem. In those exposed to it, the roots after starting almost immediately ceased to grow; the strongest plant attained a height of six inches, and developed six rootlets, averaging only three-sixteenths of an inch in length, while those not exposed to ozone had many roots exceeding two and a-half inches. As a whole, the roots produced by the plants under the influence of ozone did not exceed one-tenth of those produced in its absence from an equal number of healthy seeds. One curious result of the almost total absence of roots was that the wheat plants were scarcely able to sustain themselves in a vertical position; the greater part of them fell over on one side. The flatness of the grains of maize afforded their plants a better support.

The influence of ozone over the production of mould was very striking. When seeds were placed in contact with water and with the air under a bell-glass in which a vessel of water stands, which air is of course saturated with moisture, mould began immediately to form, and increased until the surface of the gauze which rested on the water was completely covered. Nothing of the sort was visible in the bell-glass containing an ozonised atmosphere.

In order the better to observe the influence of ozone upon the mould, the vessel which contained it was transferred to the bell-glass of which the atmosphere was ozonised. In the course of a few hours, the greater part of the mould fell back upon the gauze as a yellowish powder, while two healthy young maize plants appeared unaffected, and continued their development. With a longer exposure, they would of course also have suffered, but their stronger vitality enabled them to resist longer. It was also remarked that the extremities of the leaves of some wheat plants, growing in the same vessel, became yellow. But those wheat plants which had germinated in the ozone atmosphere, although much smaller, were perfectly healthy, and the leaves showed no disposition to die at the ends.

Pasteur has lately shown that the putrefaction and oxidation of organic bodies is effected to a very large extent by the intervention of the lowest order of vegetable organisms. That in some cases where the germs of these



bodies have been carefully excluded, milk, for example, has been kept in the presence of atmospheric air for a year without alteration; and that when sawdust was enclosed in a flask for a month, the germs being similarly excluded, the air still contained 16 per cent. of uncombined oxygen.\* It therefore appears that ozone, while a highly oxidising agent, may in some cases check putrefaction and oxidation by destroying the intermediate agencies, through which these operations are effected; a fact not without interest in connexion with the alleged influence of ozone on epidemics.

The experiments just described were carefully repeated with the substitution of very pure river water, instead of that containing the salts already mentioned. The results obtained were precisely the same. These trials afforded a double set of parallel experiments, similar sets of seeds having been exposed to the action of saline solutions, and to that of river water nearly pure, in both cases with and without the influence of ozone. Clearly, therefore, to nothing but ozone could be ascribed the inverted tendency of the roots, as this always followed its presence, and never appeared in its absence.

**2. Carbonic Acid.**—Experiments were made to ascertain the effect of a complete removal of carbonic acid from the atmosphere surrounding plants. The seeds were placed on gauze strained over a vessel of water, which was set in a dish containing concentrated solution of caustic soda, and the whole was covered with a bell-glass. A similar arrangement was made, exclusive of the caustic alkali, to afford a term of comparison.

No appreciable difference could be observed. It is probable that seedlings, within the height which they can attain under an ordinary bell-glass, still derive a sufficient supply of carbon from the seed. Be this as it may, the removal of carbonic acid from the atmosphere surrounding them did not interfere with their growth.

Experiments made with seeds placed in an atmosphere of carbonic acid accorded with results obtained by other observers, as to total prevention of germination under circumstances otherwise favourable. The seeds, however, were found to be not in any way injured, and germinated freely on exposure to the atmosphere.

It seems probable that in those cases in which germination has been observed to take place in an atmosphere of carbonic acid gas,† the exclusion of atmospheric air has not been sufficiently well maintained.

**3. Simple and Compound Ethers.**—Seeds were placed on gauze under a bell-glass, as before, and an open narrow-mouthed phial containing a little ether was introduced. Germination was entirely prevented.

Nitrate of methyl produced a similar effect.

**4. Organic Acids in Solution.**—Two organic acids were selected for experiment—oxalic acid as being reducing, non-nitrogenous, and sharp; picric acid as oxidating, nitrogenous, and bitter. Both were dissolved in water in the proportion of three-tenths of one per cent. Germination was found to be entirely prevented, by the presence of even so small a quantity of these substances. To ascertain if this effect resulted from the acid reaction of the solutions, other solutions were made of oxalate and picrate of ammonia, so proportioned that each solution should contain precisely the same proportion of acid as before—viz., three-tenths of one per cent. In the neutral solution of oxalate, a slow germination followed; in that of picrate none whatever.—*American Journal of Science and Art*, Vol. xxxvii., May, 1864.

*Note on a Coloured Derivative of Naphthaline*, by M. CAREY LEA.

IN the course of an examination of the compounds of naphthaline, the following observation was made, and, as at the present day, every coloured reaction belonging to the products of coal distillation is a matter of interest, I publish it.

While preparing some sub-chloride of naphthaline,  $C_{20}H_8Cl_3$ , by passing chlorine over naphthaline, I washed the crude product with ether, and separated the etherial liquid by filtration. By exposure to the atmosphere the ether passed off; there remained a small quantity of a pale yellow transparent watery acid liquid, which separated itself from the denser and more coloured portions. Placed by itself in a small capsule, it deposited after a time a bright blue film. The liquid was passed off from this film into another capsule, when it gradually deposited a further portion.

The quantity of this blue substance obtained was exceedingly small. It exhibited the following properties:—It was insoluble in water, in alcohol, and in ether. Exposed to an ammoniacal atmosphere, it passed quickly to a full deep purple; vapour of chlorhydric acid restored the blue shade. Ammonia in the form of solution wholly destroyed the colour, nor was it then restored by chlorhydric acid as when it had been rendered purple by ammoniacal vapour.

This reaction of a blue substance changed to purple by a small quantity of ammonia, and wholly decomposed by excess, is something quite new, and it is to be regretted that the substance is only obtainable in infinitesimal quantities as a by-product.—*American Journal of Science and Arts*, vol. xxxviii., November, 1864.

## TECHNICAL CHEMISTRY.

*On the Chemical Effects of Incandescent Fuel on Steam Boilers, and the Chemical and Physico Chemical Effects of the Feed-water*, by F. A. PAGET, Esq., C.E.

(Continued from page 220.)

An explanation which seems to meet all the circumstances of the case is the following:—Mr. Mallet, in a report addressed to the British Association some years ago, showed that wrought iron and steel (blister steel probably), “consist of two or more different chemical compounds, coherent and interlaced, of which one is electro-negative to the other.” In fact, ordinary wrought iron, being also welded up from differently worked scrap, is far from being an electro-homogenous body. In a boiler, the hot water, more or less saturated with chemical compounds, is the exciting liquid, and the electro-positive portions of the plates are thus quickly removed to a greater or less depth. This explanation meets most of the known circumstances with respect to pitting; it even, in a great measure, explains how plates above the level of the water, especially in marine boilers, get very rapidly corroded in portions, while another part of perhaps the same plate is scarcely affected. The concentrated water in a marine boiler is known to be generally acid. “Of all the salts contained in sea-water,” says Faraday,‡ “the chloride of magnesium is that which acts most powerfully” on the plates. He shows that a cubic foot of sea-water contains 3.28 oz. of this salt; and, at the same time, points to the danger of voltaic action in a boiler through the contact of copper

\* See *Rép. de Chimie Pure*, September, 1863, p. 479.

† Lindley, “Introduction to Botany,” p. 359.

‡ Fifth Report of the Committee of the House of Commons concerning the Holyhead Roads, p. 194.

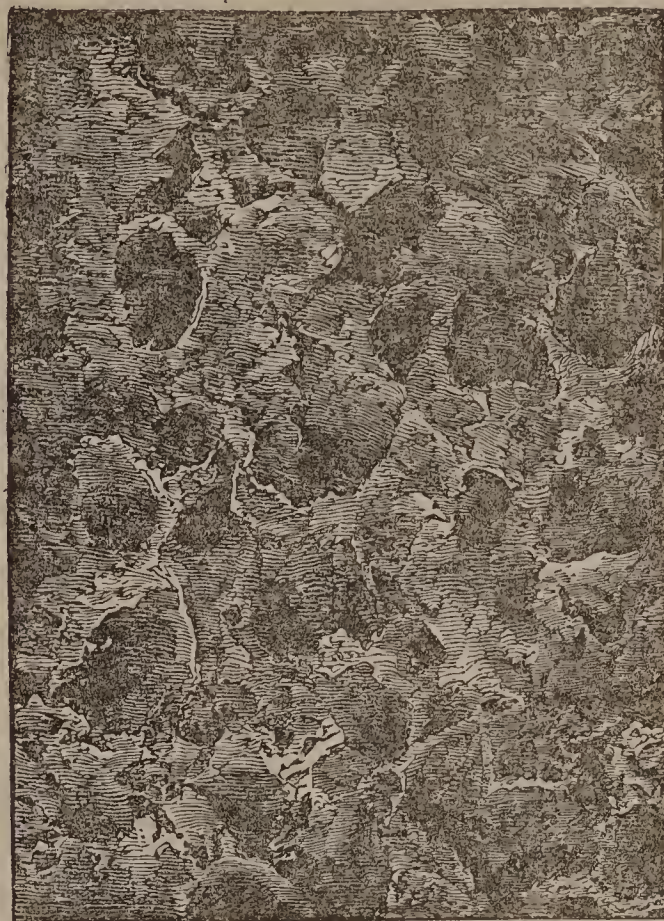


and iron. In a smaller degree the contact of cast with wrought iron, or between the different makes of wrought iron in the same plate, or between contiguous plates, acts in the same way. It is not improbable that some hydrochloric acid is present in the steam of marine boilers. "Mr. J. C. Forster§ has tested some of the condensed steam from the safety-valve casing, and from the cylinder jacket of the Lancefield, and found both decidedly acid."|| With an exciting liquid in the condensed steam, it is thus explicable how the plates of marine boilers often get corroded in a most capricious manner; while at the same time, the current of steam would create a certain amount of friction on the oxide, clearing it away to act on a fresh surface.

The crucial test of this explanation of pitting would be the observation of the absence of the phenomenon from plates of an electro-homogenous character. This homogeneity could only be expected from fused metal, such as cast-steel. Accordingly, while the writer was in Vienna a short time ago, he was assured by Mr. Haswell, the manager of the Staatsbahn Locomotive Works, that some locomotives made of cast-steel plates in 1859, for the Austrian Staatsbahn, had been working ever since without showing signs of pitting, though under similar conditions iron plates had severely suffered in this way. Pitting may thus be fairly defined as a form of corrosion localised to particular spots by voltaic action. It is also probably aggravated through the motion of the plate by mechanical action, and the expansions and contractions through alternations of temperature. All boilers are most pitted near the inlet for the feed water, and with inside cylinder locomotive boilers there is generally more pitting at the smoke-box end—no doubt caused by the more or less racking action on these plates. A state of corrosion at particular spots would probably be kept up to a greater intensity by the incrustation being mechanically thrown off. With a quicker voltaic action, caused by any unusual intensity of the exciting liquid, the sides of the cavities in the plates would be sharper and less rounded off; as in the case of the boiler fed with mineral water from ironstone workings, which exploded last year at Aberaman, South Wales. (See Fig. 2.)

The fact that pitting occurs in marine boilers when distilled water from surface condensers is used, does not affect this explanation. Water distilled in this way, from whatever cause, after repeated boiling, is stated to carry the salinometer even higher than sea water, thus proving that it is not pure.¶ In the next, there is the absence of incrustation, which to some extent always protects the plates of boilers from the chemical action of its contents. In this way the mechanical buckling of the plates—directly and indirectly causing the furrows we have spoken of—by continually clearing particular lines of surface from incrustation and oxide, reduces these particular spots, with respect to corrosion, to the condition of the plates of a boiler fed with water which deposits no incrustation. Corrosion will also act more rapidly at a furrow through mere increase and renewal of surface. To resist that form of internal corrosion especially known under the name of pitting, a maximum of electro-homogeneity is evidently required in all the component parts of the boiler.

FIG. 2.



(From a photograph of surface of corroded plate cut from one of the two boilers that exploded on Wednesday, February 17, 1864, at Aberaman Iron Works, Aberdare. The corrosion was internal, and in some parts the plate was not more than one-eighth thick. Thirteen persons were killed and many others seriously injured.)

While the action of internal corrosion, often very equally corrugating the plates over a large surface, as a rule scarcely, at any rate only gradually, affects their mechanical strength, external corrosion, being localised to particular spots, is of a much more dangerous character. The one is gradual and easily perceptible, while the other is rapid and insidious in its progress. Apart from accidental circumstances affecting the brickwork on which a stationary boiler is erected, or the outside of the bottoms of marine boilers, it is clear that external corrosion can only occur through leakage. When leakage takes place through a crack in the plate caused by mechanical action, or at a hole burnt out by heat, the effects of leakage are only secondary results, due to a primary cause which of itself may cause the stoppage of the steam generator. But a leakage at a joint may in itself gradually cause the destruction of the boiler. Here we see another reason that the character of a boiler, not merely as to ultimate strength, but also as to wear and tear, intimately depends upon the form of its joints. It is often noticeable that very good lap joints, even when tested under hydraulic pressure up to only 50 per cent. above the working load, sweat more or less. The tendency of the internal pressure to form a correct circle bears indirectly on these joints, causing them to open more or less, and to leak, in spite of the caulking. Mr. Robert Galloway, C.E., who, as an engineer surveyor of long standing of the Board of Trade, has probably made more than 3000 careful inspections of marine boilers, states that he has often noticed a furrow or channel on the outside of the joint, running parallel to the outside overlap for some distance, and evidently caused by leakage. Along the water line, condensed water will act on the joints, while below it the concentrated contents of the boiler will come into chemical action. A leakage in a marine boiler often eats away a plate within a year. In some cases a jet of hot water from a leakage has a frictional action; in fact, even with such an incorrodible and hard substance as glass an

§ Institution of Engineers in Scotland, 1864—5. Introductory address by Mr. J. R. Napier.

|| When a solution of chloride of magnesium is evaporated nearly to dryness, the salt and the water are decomposed, magnesia and free hydrochloric acid being formed; or  $\text{MgCl} + \text{HO} = \text{MgO} + \text{HCl}$ .

¶ Institution of Mechanical Engineers, 1863. Discussion on Mr. James Jack's paper "On the Effects of Surface Condensers on Steam Boilers."



effect like this has been perceived, and a slight leakage continued during several days sometimes produces a noticeable furrow on a glass-gauge tube. With sulphurous fuel, a powerful chemical-action will come into play on the plates. One volume of water takes up about thirty volumes of sulphurous acid gas; and these sulphurous fumes of the fuel, coming into contact with the water from a leakage, will be more or less absorbed. An acid solution like this must quickly eat away the plate. It is certain that a leakage acts much quicker on a boiler fired with sulphurous fuel than on one fired with wood. M. G. Adolphe Hirn has observed a plate, nearly seven-eighths thick, to be pierced, in the course of time, as with a drill, by means of a little jet which struck it after passing through a current of hot coal smoke.\*\*

## PHARMACY, TOXICOLOGY, &c.

### *Mysterious Case of Poisoning at Dawlish.*

A RECENT number of the *Western Times* informs us that the Dawlish people have lately been much excited by a rather remarkable case of suicide committed at the York Hotel. We have been interested in this case on account of certain physiological and forensic circumstances associated with it, a trustworthy account of which we have received from a correspondent, and with the main points of which we shall now make our readers acquainted. The lady who committed suicide had several parcels of "rat poison" in her reticule or about the room, some of which had been opened, others kept as if in reserve. Two papers of "Simpson's vermin killer" and one parcel of Battle's had apparently been used. Some blue stains were found in the mouth and at the angles of the jaw, the pocket handkerchief being also stained in like manner. The rigidity and contortions of the dead body led Dr. Baker, of Dawlish—who was called in to see the deceased when she had been dead two or three hours—to infer that strychnia had been the cause of death. He sent the viscera to Dr. Bird Herapath, of Bristol, who from analysis proved that arsenic was present in abundance in the gastric mucus and in the coats of the stomach, but that strychnia was not in either of these materials. Dr. Herapath found likewise traces of arsenic in the liver. What is the explanation of this discrepancy of analysis and condition of body and mode of death? As Dr. Herapath observes, if strychnia were taken it never got into the stomach at all. It is probable, however, as this gentleman explains it, that the first two packets did not kill her as quickly as she intended, and that she then took the third packet, but that its contents never went further than the mouth. Some portion was ejected in consequence of the bitter taste, and to get rid of what remained of the latter an almond was taken. Enough, however, of the powder (starch, Prussian blue, and strychnia, similar to what was employed in the Vyse case) remained behind to kill by absorption through the mucous membrane of the tongue, &c. The Coroner, at the adjourned inquest, declined Dr. Herapath's evidence, as he had not given any order for a chemical analysis, and now objected to the county being put to the expense. "He said there could be no doubt that the case was one of suicide, therefore an analysis was unnecessary." The magistrates were very particular, and would not allow the expenses. Dr. Baker said the Coroner had left the

case with him. A country practitioner was not supposed to make an analysis, and he (Dr. Baker) was not prepared to state the cause of death, unless the evidence of Dr. Herapath was taken. Dr. Herapath said the law was at fault, as a medical gentleman was allowed only two guineas for making a post-mortem examination, and no man of education could be expected to do it for that sum. The Coroner replied that he could not and would not let medical gentlemen act as Dr. Baker had done without the Coroner's instructions. Dr. Herapath then made a voluntary statement, foregoing the usual fee. "He stated that death had been caused by arsenic, a quantity of which, found in the stomach, he then produced. The jury heartily thanked him for his kindness, and returned a verdict in accordance with his testimony, and that the deed was done during temporary insanity."

The medical man should have informed the coroner that an analysis was necessary, and in such a case as this the order for it would have been given as a matter of course, and Dr. Herapath would then have received his proper fee.

## PHYSICAL SCIENCE.

*On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood Stains,†† by H. C. SORBY, F.R.S., &c.*

(Continued from page 196.)

If blood be dried on white linen, and exposed to the air, the bright scarlet colour changes by degrees into brown. This fact must be well known, but so far as I am aware, has not been studied optically or chemically. When the change has not proceeded far, the blood yields a spectrum like that shown by No. 3. The two well-marked bands in the green are much the same as in fresh blood; but there is also one in the red, having its centre at  $1\frac{1}{3}$  above D; and, therefore, a trifle lower than Fraunhofer's line C. The intensity of this band shows the amount of change; and, when it has become complete, the spectrum is very different from that of fresh blood, as shown by No. 4. In this change the bands below D in the green become more and more faint, especially the upper, which finally is only just visible. A larger quantity of blood is required to show spectrum No. 4 than to show No. 2; and if the solution be strong enough, only a dirty-brown red light is transmitted, with a dark band in its centre. When kept under similar conditions, the extent of this change serves to show the length of time since the blood was fresh; and at one time I hoped that by this means it would be possible to determine the time with some confidence, which would often have been very valuable in criminal inquiries. In some cases it might, indeed, be made available, but in and near a town it could not be relied on at all. When sealed up in a glass tube in a perfectly dry state on linen, it would give such a spectrum as No. 3, after having been kept for two or three months; but when sealed up wet, there is apparently little or no such change. It thus appears that it partly depends on being dry, but will take place independently of being exposed to atmospheric influences. These, however, greatly accelerate it. Exposed to the air on Burbage-moor, six miles from Sheffield, and about 1000 feet higher, one or two miles from any house, the change took place more rapidly, so that the spectrum was nearly as No. 3, after a week or so; whereas in the centre of

\*\* *Bulletin de la Société Industrielle de Mulhouse*, 1861, p. 558.

†† From the *Quarterly Journal of Science*.



the town as much action took place in a few hours. Kept in the house, the rate of change varies very much accordingly as gas is burned in the room or not; and, when I had ascertained this fact, I concluded that it must be due either to carbonic or sulphurous acid. I therefore kept some in a flask with carbonic acid, without being able to perceive any marked effect, whereas sulphurous acid disseminated in a large quantity of air turned it brown very soon, and caused the spectrum to change from No. 2 to Nos. 3 and 4; but if much acid be present, it produces a more complete decomposition, and the absorption-bands are not so distinctly visible. It appears, therefore, that this change in the colouring-matter takes place in dry blood, whether exposed to the air or not, but is greatly accelerated by free exposure to fresh air, and especially by the presence of the sulphurous acid produced by the combustion of coal or gas. Light appears to have little or no influence. Carrying out the nomenclature of Professor Stokes,†† I suggest that the brown colouring matter thus produced should be called "brown cruorine." Though it is apparently dissolved by water, and yields a clear solution, yet it is doubtful whether it is soluble in the most strict sense of that term. Close-grained filtering paper removes a great part, and on standing for some time the finer particles collect and subside. It is also difficult to dissolve it from linen or similar material without repeatedly moistening and squeezing it with forceps, so as to detach the minute particles, some of which remain quite firmly attached; and on the whole it is an excellent example of a connecting link between substances that are really dissolved by water and those which can only be disseminated through it in comparatively large particles.

If ammonia be added to a solution which would give such a spectrum as No. 4, we obtain one like No. 5. The band in the red disappears, those in the green become far more distinct, and the spectrum is similar to that of fresh blood, only the bands are more faint, and it is slightly shaded up to half above D.

If a small quantity of a strong solution of this brown cruorine be placed on a piece of glass, and allowed to evaporate slowly, the greater part collects as a dry film round the outside of the drop; and, when examined on the stage of the microscope, it yields a spectrum like 4 or 5, accordingly as it is damp or quite dry. If dry, the spectrum is very similar to that of fresh blood, only the absorption-bands are less distinct; but when breathed on, so that it may again become damp, the dark band in the red makes its appearance, and those in the green become more faint. These changes take place over and over again, though they gradually cease after some days; and hence it would appear that the dark band in the red depends on the presence of moisture, and may be due to the formation of some hydrous compound, decomposed on drying. The scarlet cruorine of fresh blood, treated in the same manner, exhibits no such changes, and gives the same spectrum as its solution in water.

Drying solutions of blood on glass in this manner gives very satisfactory results, and specimens so prepared may be kept in that state, or under thin glass fixed down with Canada balsam, without there being any sensible alteration after above half-a-year. The solution may be placed on a small square of thin glass till it has evaporated and become reduced to a drop or so, and then, having re-dissolved the dry part in the liquid, it may be allowed to run off at one corner to the glass on which it is to be kept, leaving the minute foreign fragments behind. If, however, the mordants

used in dying the fabric have changed the blood to hæmatin, the results are not satisfactory. A solution of fresh blood mounted in a cell still gives the characteristic spectrum after some months, though more faintly than at first. Brown cruorine soon forms a deposit, and loses its character when thus kept.

Professor Stokes has described the change produced by the action of deoxidising agents on fresh blood. Whether the cruorine be fresh and scarlet, or have been more or less converted into the brown modification, if citrate of ammonia be added to an alkaline solution, so as to prevent the precipitation of oxide of iron, and then, having introduced it into a cell, if a small piece of crystallised protosulphate of iron be added, and broken up and stirred till dissolved with a platinum wire flattened at one end and bent at right angles so as to form a sort of little hoe, we obtain the spectrum No. 6. There is one well-marked absorption-band, the centre of which is  $1\frac{1}{8}$  below D, and a general shading upwards as far as D. Hence it is clear that the change from scarlet to brown cruorine is not of such a nature as to prevent both from yielding the same spectrum when deoxidised; or, as described just below, from most readily passing into hæmatin, when acted on by a weak acid. So far I have been unable to decide whether the difference consists in brown cruorine containing more oxygen or water, or in its being only an isomeric modification of the scarlet. However, since such a powerful oxidising agent as permanganate of potash does not produce it, and since it is not formed in solution or when damp, the latter supposition appears to me to be the most probable, unless, indeed, it contains less water.

Professor Stokes has shown that weak acids convert cruorine into hæmatin,§§ and has described the spectrum produced by it in its natural state and when alkaline and deoxidised. On adding acetic acid to a solution of either scarlet or brown cruorine, a spectrum is obtained like that shown by No. 7. There is a well-marked absorption-band in the red, the centre being situated at  $1\frac{1}{2}$  above D, and, therefore, rather higher than that in the case of brown cruorine, and very nearly in the position of Fraunhofer's line C. There is also another at about  $1\cdot4$  below D, and perhaps a third still lower, which is only seen when the solution is more dilute, and even then so obscurely that its existence appears doubtful. When dried on glass the band in the red does not disappear; and when the solution is strong, ammonia causes a precipitate, as though hæmatin were much less soluble in ammonia than either scarlet or brown cruorine. However, the solution being somewhat dilute, using about  $\frac{1}{3}$ rd or  $\frac{1}{4}$ th of a grain of citric acid to prevent the subsequent precipitation of oxide of iron, adding ammonia in decided excess, and introducing the whole into a cell; if about  $\frac{1}{20}$ th or  $\frac{1}{30}$ th of a grain of crystallised protosulphate of iron be dissolved in the solution, we obtain the very well-defined spectrum of deoxidised hæmatin shown by No. 8. The centre of the upper band is  $\frac{7}{8}$ ths below D, and of the lower at 2. The upper part is about  $\frac{1}{2}$  wide, very dark, and sharply defined; the lower nearly the same width, but much more faint. Neither is much shaded at the edges, and both vary more in darkness than in width, on increasing or decreasing the strength of the solution or the length of the cell in which it is examined. When concentrated and in a tube  $\frac{1}{2}$  an inch long, the width of the bands is much as shown, but the shaded part is darker. In a tube  $\frac{1}{8}$ th of an inch in diameter, a spectrum as distinct as No. 8 is given by  $\frac{1}{100}$ th of a grain of liquid blood,

†† *Proceed. R. S.*, xiii., 355.§§ *Proceed. R. S.*, xiii., 357.



making on thin linen a spot about  $\frac{1}{10}$ th of an inch in diameter; and such a minute quantity will show the bands faintly, yet distinctly, that  $\frac{1}{1000}$ th of a grain of blood would be quite enough to furnish us with unmistakable evidence of its presence, if some little care and trouble were taken over the experiment, and the solution examined in a cell not more than  $\frac{1}{10}$ th of an inch in diameter.

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"On the Food of Man in relation to his Useful Work." By  
LYON PLAYFAIR, C.B., LL.D., F.R.S.

(Continued from page 224.)

#### DIVISION II.

#### Application of the Preceding Data to Elicit the Source of Useful Work.

13. The common experience of mankind teaches us, that when work is to be obtained from an animal, it must be supplied, in proportion to the labour, with food rich in flesh-formers. Thus a horse, when at work, must be fed with oats or beans, both rich in flesh-formers; a supply of potatoes or turnips, both abounding in heat-givers, would not enable it to do its work. Professor Dick, the head of the Veterinary College in Edinburgh, tells me that a horse may be kept without work, but taking a little exercise, in fair condition, on 12 lbs. of hay and 5 lbs. of oats; but if a good amount of work is to be got out of it, the horse should get 14 lbs. hay, 12 lbs. oats, and 2 lbs. beans. These diets reduced, as regards their flesh-formers, are as follows:—

Horse at rest	. 29.2	ozs. of flesh-formers.
Horse at work	. 56.2	" "

Diff. for work	27.0	" "
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The labour of a horse is generally taken as equal to that of between seven and eight men; and as the working food of a labourer is  $5.5 - 2.0 = 3.5$ , the proportion

$$3.5 : 27 :: 1 : x,$$

in which  $x = 7.7$  leads to the same result. Again, if we compare the labour and food of a horse and of a man when doing the same kind of work—that is, pulling weights horizontally—we have the following ratios, which, from the different character of their food and assimilative processes, must be made upon the flesh-formers actually expended on work external to their body:—

Work of horse, Morin*	$\frac{12,400,000}{1,500,000} = 8.$
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Work of man, Rankine†	
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Labour flesh-formers in the food of horse	$\frac{27}{3.5} = 7.7.$
" " " food of man	

These ratios are as near as we can expect with animals of such a different character. If we take again two labouring animals of the same herbivorous nature—the ox and horse,—we can compare their labour and food without complicating the question by deducting the quantity required for *opus vitale*. The Sussex farmers find that an ox is well fed on 50 lbs. mangold-wurzel, 3 lbs. beans, and 17 lbs. wheaten straw, the flesh-formers in this food being 38.6 oz. Muschet‡ has given us the labour of an ox, from which we obtain the following ratios:—

Work of horse in foot-pounds,	$\frac{12,400,000}{8,640,000} = 1.43.$
Work of ox	

Plastic food of horse,	$\frac{56.5}{38.6} = 1.46.$
" food of ox,	

\* Morin, *Mech. Trans.*, by Burdett, p. 397.

† *Ency. Brit.*, article Mechanics.

‡ As quoted in Rankine's "Mechanics."

14. These numbers, so far as they go, appear to indicate that the external dynamical work of animals is proportional to their plastic food. But this is only the common experience of man. The miners in Chili, who work like horses, also feed like them, for Darwin tells us that their common food consists of bread, beans, and roasted grain. During our harvest in Scotland, the reapers consume about eight ounces of plastic nutriment daily (Christison). Our railway contractors know this necessity of the system so well that they are accustomed to discharge labourers when their appetites fail (Lankester). And, generally, the previous diet tables prove this amply, by showing a constant increase of 30 per cent. of flesh-formers in a labouring diet over one fitted for health without hard work, as contrasted with a varying increase of from 5 to 20 per cent. in the heat-givers.

15. Having thus rendered it probable that we are to look to the plastic ingredients of food as exponents of dynamical action, both internal and external to the body of a man, let us now examine the transformations which they suffer. All chemists are agreed that the final transformation of plastic matter in the body yields carbonic acid, water, urea, and sulphuric acid. Those who believe that the transformation takes place in the blood agree on this point with those who consider that it is effected in the tissues.

If we take the simplest possible *empirical* formula for albumen, or of tissue formed by it, one representing analysis merely, and not constitution, our views may be more easily understood. Such a formula is  $C_{24}H_{38}N_6O_{16}$ , in which the 1.2 per cent. of sulphur is for the present supposed to play the part of oxygen:—

	Calculated.	Mean of analysis.
24 C, . . . 288	53.55	53.8
38 H, . . . 38	7.06	7.0
6 N, . . . 84	15.61	15.7
16 O, . . . 128	23.78	{ S 1.2 O 22.3
	538	100.00
		100.0

The transformation of this generic tissue-forming body, still omitting the sulphur, would be as follows:—

Albumen.	Urea or amido-carbonic acid.	Carbonic acid.	Water.
$C_{24}H_{38}N_6O_{16} + 100O =$	$3(CO_2(NH_2)_2) +$	$21(CO_4) +$	$13(H_2O_2)$

The simplicity of the transformation is remarkable. Water and two forms of carbonic acid are alone produced; of the latter amido-carbonic or urea is secreted with water *per vesicam*, and the gaseous carbonic acid, accompanied by watery vapour, passes away *per halitem* or *per cutem*. If this empirical formula be a fair representation of analysis, and it claims to be nothing more, then, as the result of the transformation, *seven* times as much carbon should escape by the lungs and skin as by the urine. We can only test this when animals are fed on a flesh diet free from fat. Luckily there are two classes of experiments of this kind, one of them being by Bischof and Voit,§ and the other by Pettenkoffer and Voit.|| The results of the former, omitting the starving experiments on the dog, are as follows:—

	Grammes of Flesh.	C in Urea. Grammes.	C in CO <sub>4</sub> . Grammes.
First Series	. 1800	24.2	180.8
Second "	. 1500	21.6	162.1
Third "	. 1200	17.7	132.6
Fourth "	. 1800	24.9	186.5
Fifth "	. 1800	25.6	223.3
Sixth "	. 2000	30.3	228.5
Mean .	. 1383	24.0	185.6

Before using these figures, we must correct them for the one per cent. of fat which, according to these authors, still remained in the flesh. If we suppose the fat to contain 77

§ *Die Gesetze der Ernährung der Fleischfressers*, S. 61, et seq.

|| *Ann. der Ch. and Phar.*, Supp. Bd., 1863.



per cent. of carbon, then 13.83 grammes of fat, in the average daily supply of 1383 grammes of flesh, would contain 10.6 grammes of carbon. Hence we have in reality 175 grammes of the carbon in the carbonic acid due to the flesh alone. From this we obtain the ratio—

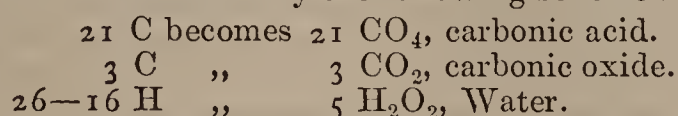
$$24 : 175 :: 1 : x \quad . \quad . \quad . \quad x = 7.29.$$

In Pettenkoffer and Voit's experiments, conducted in a like way, but where no correction requires to be made for fat, 21.6 grammes of carbon were found in the urea, and 148 grammes in the carbonic acid, and small quantity of carburetted hydrogen, which escaped by the lungs and skin. Hence we have—

$$21.6 : 148 :: 1 : x \quad . \quad . \quad . \quad x = 6.85.$$

The mean of these two independent series of experiments shows that 7.07 times as much carbon passes away in the form of carbonic acid as we find in urea, our equation having required 7.0.

16. Having established the fairness of the equation of transformation, we have to ascertain its calorific value. Although we are well aware, as has been shown by Berthelot<sup>¶</sup> and others, that this depends for absolute truth on a thorough knowledge of the rational constitution of a body, this need not prevent, until the progress of knowledge teaches us this, our use of approximative numbers. These we can obtain by the following scheme:—



In this scheme the hydrogen is reduced to ten atoms, because there are already sixteen atoms of oxygen in the tissue, which may be supposed to have united with that element without increase of temperature. The calorific units employed are those of Andrews—viz., 7900 for carbon, 33,808 for hydrogen, and 2307 for the 1.2 per cent. of sulphur in albumen. We do not know experimentally how much heat is given out when carbon unites with oxygen to produce carbonic oxide; but as we do know how much the latter gives out on becoming carbonic acid, it is easy to calculate how much heat a gramme of carbon would evolve on becoming carbonic oxide. The unit of heat by this calculation would be 2227.7. It will now be convenient to ascertain by these numbers how much heat would be given out by the transformation of one ounce or 437.5 grains\*\* (28.35 grammes) of tissue. A little calculation shows that this quantity would yield as much heat as would raise 126.5 kilogrammes of water 1° C. This, converted into its mechanical equivalent, gives:—

$$126.5 \times 425 = 53,762 \text{ metre kilogrammes.}$$

17. These numbers can easily be applied. Thus we have seen that a labourer receives 5.5 oz. (155.92 grammes) of flesh-formers in his food. The potential energy represented by this quantity is 295,691 metre kilos.; while the man's labour of raising his own weight one mile high per day is 109,496 metre kilos. But we have not yet deducted the amount of energy required for *opus vitale*, in which

we include internal, dynamical, mental, and assimilative work. Concurring estimates of the force exerted by the heart have been made by Helmholtz<sup>††</sup> and Haughton.<sup>‡‡</sup> The latter estimates it at 122 foot-tons, or 273,280 foot-pounds, which is more than one-third of the useful work done out of the body. Now, although the motion of the blood in the human body depends almost entirely upon the heart, there are at least indications in man, and clear evidences in plants,<sup>§§</sup> and in the lower animals, that there are other movements in the system without any *vis a tergo* from an impelling body. If the heart do not use the energy placed at its disposal more economically than the conscious man does the amount with which he works, then it would require nearly one ounce, or exactly 1.20 oz. (theoretically, 0.702 oz. should suffice) of the plastic food. This is very nearly one-half of that which is required for subsistence. The two ounces of flesh-formers used in subsistence would yield by their transformation 253 units of heat, or a mechanical equivalent of 107,524 metre kilos., while the work of the heart is only 37,781 metre kilos. But in addition to the other dynamical work within the body, there is also included in this subsistence quantity both a limited amount of mental work and a full proportional of assimilative work. In the dynamical work, besides the cardiac movements, there are those of the respiratory apparatus, of the diaphragm, of the intestines, and of the arteries. All these in the aggregate represent a considerable, though numerically unknown, demand upon plastic food. And finally, we have the mental work, not considerable certainly, in a man fed upon a minimum diet, but probably requiring a certain amount for the manifestations of mind to the material world. We cannot therefore be surprised to find that double the amount of energy necessary for the cardiac movements is supplied for the whole functions included in *opus vitale*.

18. The *opus mechanicum* or external dynamical work done by the body of a hard-worked labourer, is to be sought in the 3.5 ounces (99.2 grammes) of flesh-formers which remain after deducting the amount required for *opus vitale* from the total plastic food. But of this quantity one-twelfth appears in the alvine evacuation, without being formed into tissue, and the remainder yields 405 units of heat, or its mechanical equivalent of 172,125 metre kilos.; while the actual amount of useful work performed by the man is 109,496 metre kilos.

19. When we contrast the useful work of a steam-engine with the potential energy supplied to it, this economy of force on the part of the man must appear surprising. But even in the rough mode of calculation available to Scoresby and Joule, to Dumas and Helmholtz, before our knowledge of dietetics had enabled us to consider this question in a more precise way, the relative economy of the human machine excited their surprise. And yet our demand for economy is much greater than they supposed to be necessary, for we require that more than half of the potential energy should be converted into useful work.<sup>|||</sup> It may be therefore necessary to adduce general arguments in support of the view that the dynamical action of the body depends wholly on the transformation of the tissues.

(To be continued.)

Friday Evening, May 12, 1865.

"On Magenta and its Derivative Colours."

By FREDERICK FIELD, F.R.S.

THREE years ago, in this theatre, Dr. Hofmann delivered his celebrated lecture on mauve and magenta, and it might

<sup>¶¶</sup> Lectures at Royal Institution, Lect. VI.

<sup>‡‡</sup> New Theory of Muscular Action, p. 23.

<sup>§§</sup> Carpenter's Physiology, p. 215.

<sup>|||</sup> It would take from 1000 to 1200 grammes of coal burned in a steam-engine to raise a man from the level of the sea to the top of Mont Blanc; but the same man could do this work in two days by the transformation of 198.4 grammes of dry muscle.

<sup>¶¶</sup> Acad. de Science, January, 1865.

\*\* The details of this calculation are as follows:—

One ounce of albumen contains—

Carbon	..	..	..	..	235.37 grains
Hydrogen	..	..	..	..	30.62 "
Nitrogen	..	..	..	..	68.68 "
Sulphur	..	..	..	..	5.25 "
Oxygen	..	..	..	..	97.56 "

437.48

This, treated according to the equation given:—

$$\text{C. } 201.75 \times 7,900 = 1,593,825$$

$$\text{C. } 33.62 \times 2,227.7 = 74,895$$

$$\text{H. } 8.05 \times 33,808 = 272,154$$

$$\text{S. } 5.25 \times 2,307 = 12,111$$

1,952,985

$\frac{1,952,985}{1 \text{ kil.} = 15,432 \text{ grs.}} = 126.5 \text{ kilogramme units. To convert this into mechanical force:—}$

$$126.5 \times 425 = 53,762 \text{ metre kilos.}$$



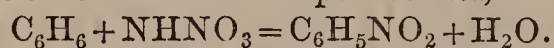
seem temerity in me to trespass upon the premises of so great and distinguished a master, were it not remembered that during that interval rapid strides had been made in organic chemistry, and especially, perhaps, in the direction of the aniline colours.

Although I will endeavour to confine myself as much as possible to the immediate subject of the lecture, it will be necessary to glance for a few moments at the history of aniline, the progenitor of nearly all the beautiful compounds you see around the table.

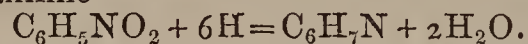
Aniline was discovered in the year 1826 by Unverdorben, who obtained it from the destructive distillation of indigo. A short time afterwards Runge and Fritsche observed that by the action of strong hydrate of potash upon the dye, aniline was eliminated in far greater quantity. Indigo in small fragments is heated in a retort with a strong solution of caustic potash, and in the distillate, which consists of many products, there is found a thin and nearly colourless fluid, having a specific gravity of 1.028, a peculiar but not disagreeable odour, and a pungent biting taste. When kept for some time, even in the dark and in stoppered bottles, it assumes a darker tint, and becomes ultimately a very dark brown. Unverdorben called it "crystalline," Kunge "kyonal," and Fritsche "aniline."

This substance is a nitrogenised base, and is capable, when combined with acids, of forming most beautiful crystallised salts, nearly all of which have been carefully examined by Dr. Hofmann and other chemists.

There are many other sources besides indigo, from which aniline may be obtained. For commercial purposes it is always prepared from nitro-benzol, a substance derived from the action of nitric acid upon benzol,—



Nitrobenzol when agitated with water, acetic acid, and iron yields aniline—



Benzol, originally discovered by Mr. Faraday in 1825, in his investigations upon the gaseous products from oils, was subsequently obtained by the decomposition of benzoic acid by means of caustic lime. Mr. Mansfield, however, succeeded in producing it in much larger quantities from coal-tar naphtha. When the lighter portions of this compound are distilled fractionally, until a constant boiling point of 180°F. is arrived at, the product consists of pure benzol, identical with the carbo-hydrogen obtained by Mr. Faraday.

From the earliest discovery of aniline it was noticed that certain oxidising agents when mixed with a solution of its salts produced a fine violet tint. Even in minute quantities, a few drops of hypochlorite of lime renders it purple. There is another test for aniline, which I will show you, and which, as far as I am aware, has not been observed previously. If the red gases obtained by the decomposition of nitric acid by starch or sugar be passed into an aqueous solution of aniline, the liquid speedily assumes a yellow colour, owing to the formation of a new base—azophenylamine—which is gradually precipitated as a bright yellow powder. It was not, however, until the year 1856 that aniline was applied to any great practical purpose, although from the beauty of its compounds and from its comparative accessibility, it had, from the time of its discovery, become a great favourite with chemists.

Mr. Perkin was the first who produced colour on an extensive scale from this base. He added a solution of bichromate of potash to a salt of aniline, and from the precipitate thereby produced he isolated a magnificent purple dye he termed "mauve," which at once became popular, and, indeed, at the time, almost universal. It may truly be said that this discovery has identified Mr. Perkin with the aniline colours, and that he will be always associated with one of the most striking and brilliant passages in the history of chemistry as applied to the industrial arts.

It cannot be supposed that such a discovery would be allowed to rest. A mine had been opened which chemists began to explore, and in such numbers and with such avidity and zeal as almost to lead us to anticipate that its riches will soon be exhausted. The action of numerous bodies upon aniline and its homologues were found to be productive of colour. Nitrate of silver, nitrate of mercury, chloride of mercury, chloride of tin, arsenic acid, iodine, and many others, when heated with the base, gave a rich crimson colour in more or less abundance; and although it would be impossible for me to enter into a disquisition on the comparative merits of these various methods for the production of colour, I trust to be able to produce magenta, although in a somewhat crude form, at this lecture table, and also to dye this tassel of silk from a solution of its salt. The reagent I will employ is iodine. A few crystals of this element are placed in a tube with about twice their weight of aniline. Heat is at once developed, and with the assistance of a higher temperature from the spirit-lamp, you will observe that in a few moments intense colour is developed. If a few drops are now poured into spirit, and this solution added to water, a fine rose-coloured tint will appear.

It may seem strange to those who have read Dr. Hofmann's beautiful researches upon the aniline substitution products, his chloraniline, bromaniline, iodaniline, and a multitude of others, that he had not observed this curious reaction; and this leads me to tell you *en passant*, for time will not allow me to dwell upon this interesting topic to-night, that aniline, when perfectly pure, does not yield any amount of colour with most of the reagents mentioned above—a most important fact discovered by Mr. Nicholson and Dr. Hofmann, and which has given rise to one of the most difficult questions which yet remain to be answered. I will simply say that it appears there must be a homologue of aniline present with that base to produce the colour you see before you, although that homologue *per se* will give no colour whatever.

The tintorial power of the salts of magenta is something marvellous. No dye that I have examined, whether from the animal, vegetable, or mineral world, can bear comparison for one moment with this crimson colour obtained from aniline. One grain in a million times its weight of water gives a pure red; in ten millions, a rose-pink; in twenty millions, a decided blush; and even in fifty millions, with a white screen behind the vessel in which it is dissolved, an evident glow. Perhaps the most startling and graphic incident of this wonderful power is found in an account, which I presume to be authentic, of one of the passages of the *Great Eastern* from Liverpool to New York, some few years ago, when a hurricane swept over the Atlantic, rendering the mighty vessel powerless amid the mightier sea. After one terrific night it was observed that far around the vessel the waves seemed tinged as though with blood, faint and diluted in the distance, but deep, and crimson, and terrible in the immediate vicinity, while after every roll of the giant ship gushed forth anew a deep ensanguined flood. When the storm had somewhat abated, and search was made for the origin of this startling phenomenon, it was discovered that some tremendous billow had staved in part of the hold, and at the same time shattered some vessels containing magenta in a most concentrated form, which, sweeping over hatches and through port-holes, did, more truly than Banquo's blood on Macbeth's hand, "the multitudinous sea incarnadine."

Although the salts of magenta are possessed of such wonderful colouring power, the base itself is colourless; and it is remarkable that the union of base and acid for the formation of a salt does not appear to take place, in dilute solutions, in the cold. We have here two vessels, one of hot the other of cold water; an equal quantity of magenta base is added to each, and also an equal amount of dilute sulphuric acid. You will observe that in the



hot solution colour is instantaneously developed, while in the cold there is no change; but if hot water be added to the latter so as to raise the temperature the colour at once becomes apparent. You may judge, therefore, that, having free acid in a solution of base without production of colour, it is possible to have free alkali in a coloured solution of a salt of the base without destroying its tint. Such is the case: to these two solutions of acetate of magenta, one hot and the other cold, is added equal quantities of caustic soda; the hot liquid is rendered colourless, the cold retains its original hue.

Ethyl-rosaniline, a substitution product of rosaniline, discovered by Dr. Hofmann, and which gives a most beautiful shade of violet when in solution, is capable of affording most remarkable manifestations. This dark violet liquid, on the addition of sulphuric acid, becomes colourless; on adding ammonia the purple is restored. If hydrochloric acid is employed in small quantities the liquid changes to blue; if in larger quantities, to a brilliant green; but if this green liquid be thrown into water you will observe that the original violet returns.

When aniline is heated with salts of rosaniline, purple and blue compounds are produced. The blue is perfectly insoluble in water, but soluble in alcohol, and its solution thrown in water imparts a brilliant tint, although probably the dye is only in a most minute state of division. If a tassel of wool or of silk be plunged into this liquid, you will observe that the colour disappears from the bath, and the fabric becomes dyed; it has acted like a sponge, or, perhaps, more properly speaking, like a filter, arresting in its passage through the water the finely disseminated particles. Mr. Nicholson patented a method for obtaining a beautiful blue dye soluble in water, which consisted in heating the phenyl blue with strong sulphuric acid. This compound, however, though most advantageous for silks, refuses to impart its colour to wool, and we have before us the curious phenomena of wool and silk in the same vessel, the one of a bright azure tint, the other perfectly untouched. The effect is still more striking upon cotton. We have here the letters "R. I.," in honour of the Royal Institution, worked in silk upon a cotton ground; after dipping it for a few moments in this bath, you will see that the letters are blue and the cotton is unchanged.

There is another colour I must mention, aniline green, produced by the action of aldehyde upon acid solutions of rosaniline. This is one of the most charming colours yet discovered; the green is perfect, and you have only to compare the artificial greens made by the mixture of blues and yellows with this extraordinary dye to see the wonderful difference they present.

I have prepared a little conceit here, which may be called puerile by some, yet which I cannot help feeling is full of instruction. You are aware that the base magenta or rosaniline is colourless. Such is the case with the majority of the aniline colours. We were taught in the catechisms of childhood that there are seven primitive colours—violet, indigo, blue, green, yellow, orange, and red.

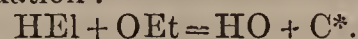
Aniline consists of seven letters, and up to the present time we have from this wonderful base obtained seven colours. On this white board the letters of aniline are written in the colourless bases, and if our experiment succeed you will find that upon sprinkling the board with acetic acid and spirit, the A will be violet, the N indigo, the I blue, the L green, the Y yellow, the O orange, and the E red, making aniline speak to us in the language of its gorgeous offspring.

I am indebted to my kind friends Messrs. Simpson, Maule, and Nicholson for the beautiful specimens of dye, many of a most costly and magnificent description, which you see before you; and to Messrs. Hands, Son, and Co., of Coventry, for the splendid array of silks so kindly furnished me to illustrate my lecture.

## ACADEMY OF SCIENCES.

May 8, 1865.

M. EM. MARTIN contributed the second part of his memoir entitled "*An Electro-Chemical Study of the Really Simple Bodies, Ponderable and Imponderable*," devoting this part to an explanation of the phenomena of combustion, and of the pile. The simplest case of combustion, according to the author, is that of a mixture of hydrogen and oxygen, which produces water and heat, and which, according to the theory we noticed the week before last, is explained by the following equation:—



The two imponderables combine to form caloric, which is produced with sufficient intensity to become luminous before it combines with the water. Carbon hold two atoms of electrile, is  $\text{C}, \text{El}_2$ . When it is once burnt in oxygen, it forms carbonic oxide  $\text{CO}, \text{El}$ ; burnt a second time with the same quantity of oxygen, it becomes  $\text{CO}_2$ , in which the two atoms of electrile are replaced by two atoms of oxygen. So with sulphur and the metals.

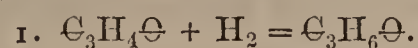
The action of the battery is a modified combustion in which the two imponderables are kept apart, and sent along different wires.

MM. Friedel and Crafts communicated their paper "*On Silicium-Methyl and Methyl-Silicic Ethers*." We announced the formation of these bodies last week. The process by which they are obtained is very simple. Chloride of silicium may be added to a mixture of zinc and iodide of methyl and the mixture heated to  $200^\circ$ . The tube or digester must be allowed to cool before it is opened, as the gas appears to be very poisonous. Rectified from potash, and then dried with chloride of calcium, silicium methyl is a limpid liquid, boiling at  $30^\circ$ , which burns with a luminous flame, scattering white fumes of silica. The composition is  $\text{Si}_4\text{CH}_3$ ; vapour density found 3.058, calculated 3.045. The authors remark the great difference in the boiling points of silicium ethyl, and methyl. The former boils at  $152.5$  or  $122^\circ$  above the latter, more than  $30^\circ$  for the increase of  $\text{CH}_2$ . Pure silicate of methyl can only be prepared from pure wood spirit. This the author procured from oxalate of methyl. Silicate of methyl,  $\text{Si}_4\text{CH}_3, \text{O}_4$  is a limpid body, having an agreeable ethereal odour, somewhat soluble in water, silica only depositing after a time in the gelatinous state. It boils at  $120^\circ$  to  $122^\circ$ . When the methylic alcohol contains a proper proportion of water instead of nominal methyl-silicic ether, a hexamethylic disilicate  $\text{Si}_26\text{CH}_3, \text{O}_7$  is obtained, boiling at  $201^\circ$  to  $202.5^\circ$ , and resembling the normal silicate.

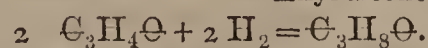
## NOTICES OF BOOKS.

*Annalen der Chemie und Pharmacie*. Supplementary Volume. Third Number.

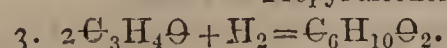
THIS extra number of the *Annalen* is principally occupied with Kopp's *Researches on the Specific Heats of Solid Bodies*, an abstract of which we published in our ninth and tenth volumes. There is, besides, a paper by Linnermann "*On the Behaviour of Acrolein towards Hydrochloric Acid and Zinc*." In a former paper the author showed that in this reaction allyl and propyl alcohols, and a third body, which he left undetermined, were formed. He now shows that this third body is *acro-pinakon*. Thus we have three hydrogenated bodies formed from acrolein.



Allyl alcohol.



Propyl alcohol.



Acro-pinakon.



The same author has also a paper "*On Pinakon*," the typical pinakon obtained by the action of sodium on acetone. This body he shows to exist in two modifications, a solid and a liquid form, as does Benz-pinakon likewise.

We have also a paper "*On Some Derivatives of Pyromucic Acid*," by H. Schelmz and F. Beilstein, and a paper by Hugo Schiff, "*On a New Series of Organic Diamines*."

*Annalen der Chemie und Pharmacie.* April, 1865.

THE first paper is by Dr. Carl Blas, "*On the Composition of the Etherial Oil of Laurel Berries*." The author undertook his researches to confirm the results of Dr. Gladstone, who found pimentic acid in laurel oil. Dr. Blas found none in the specimens he examined, but obtained a product which he identified as laurinic acid.

In a paper "*On the Metamorphoses of Mustard Oil*," Dr. Oeser states that by treating the oil with hydrochloric acid and zinc, he obtained allylamin,  $C_3H_7N$ , a colourless liquid with strongly ammoniacal smell, provoking tears and sneezing, tasting acrid, boiling at  $58^\circ C$ ., dissolving in water in all proportions, giving a strongly alkaline solution, which behaves like ammonia.

A "*Contribution to the Analytical Knowledge of Thallium*" is by M. Hebbeling, who gives the reactions of several salts of the protoxide of thallium, and also of the sesquichloride and terchloride.

A paper "*On the Chemical Nature of the Brain Substance*," by Oscar Liebreich, describes the method of separating, and the properties of, a crystalline body to which the author assigns the formula  $C_{116}H_{241}N_4O_{22}P$ , and which he names *Protagon*. This paper will no doubt attract much attention from physiological chemists.

A paper "*On the Appearance of Xanthin in the Urine*," by Dr. G. Durr, shows how the Doctor, after bathing in natural sulphuretted waters, found xanthin in his urine, and also in the urine of a patient who had had strong sulphurointment rubbed into his skin, but not after taking milk of sulphur into his stomach. The paper contains a simple process for detecting xanthin in urine. This fluid is precipitated with caustic baryta, the filtrate is carefully neutralised, and then a solution of corrosive sublimate added; a white flocculent precipitate shows the presence of xanthin.

A note "*On the Action of Hydrochloric Acid on Zinc Amid*," by D. H. Peltzer, shows that this action results in the formation of double salt of chloride of zinc and chloride of ammonium. The author adds that an attempt he made to form mercuramid by passing ammoniacal gas into mercuric ethyl did not succeed.

The next is a paper by Limpricht "*On the Products Arising from the Action of Chloride of Phosphorus on Chloride of Benzoyl*," which is followed by a communication by Schwanert "*On a Decomposition Product of Thiofurfol*."

A note by Fleitmann "*On a Method of Preparing Oxygen*," shows that when a strong solution of chloride of lime is gently heated with only a trace of freshly prepared peroxide of cobalt, a stream of oxygen is evolved and chloride of calcium is formed. The evolution of the gas is very regular when the mixture is heated to  $70^\circ$  or  $80^\circ$ . All the oxygen is given off, no chlorine acid being formed. The point most to be attended is to use a perfectly clear solution of chloride of lime; a milky or thick solution froths. We shall give the whole of this paper in an early number.

A paper of much interest by L. Carius, entitled "*Researches on Sugar, and Sugar-Resembling Bodies*," describes the method of forming Propyl-phycit, a body presenting chemically a close analogy to sugar.

The remaining papers in this number have already been noticed or published at length in our pages.

*Poggendorff's Annalen der Physik und der Chemie.*

No. 3. 1865.

THE number of the *Annalen* contains several learned and valuable papers, of which we transcribe the titles, of those, at least, which first appear in this number. "*On the Dispersion of Light in Gases*," by Dr. Kettler. "*On the Affinities of Undecomposed Bodies*," by P. Kremers; an ingenious paper, in which the author gives a fanciful arrangement of the elements of no practical value. "*On the Freezing of Water and Hail*," by Dr. Berger, which gives some original ideas on the formation of hailstones. "*On a Hydrophan found in Hungary*," a porous stone which the author employed in some diffusion experiments, by G. Reusch. "*On a Peculiar Structure of Beryl*," by Dr. Plaffs. "*On the Velocity of Sound*," a learned and important paper by Schröder van der Kolk. "*On Fluorescence*," by Professor Pisko. "*On the Difference in Heat Radiating from Rough and Smooth Surfaces*," by Magnus. "*On a Polarization Battery; a New Apparatus for Developing a Continuous Current of Great Tension by Means of Simple Elements*," by Professor Thomsen, of Copenhagen. This battery would seem well worthy the attention of telegraphists, but a description would be unintelligible without the accompanying drawing. The remaining papers are "*On some Researches to Establish the Identity of Light and Electricity*," by H. Wild, and "*On the Occurrence of Cobalt and Nickel in the Complex Mineral known in Germany as Fahlerz*," by Dr. Higer. The mineral contains so many metals that the author's analytical process is of some interest, and we may return to it.

*Journal für Praktische Chemie.* No. 3, 1865.

IN this number we find the first part of a long and valuable paper by the late Dr. Heldt, entitled "*Studies on Cements*." We may refer to this paper again, when the paper is concluded.

A contribution to the knowledge of the "*So-called Xanthocobalt Compounds*," by C. D. Braun, criticises the formulæ assigned by Gibbs and Genth to those compounds, and gives formulæ founded on the author's own results. We must refer those interested in these bodies to the original paper, which defies condensation.

A short notice "*On the Development of Sulphuretted Hydrogen*," by L. C. Levoir, informs us that when sulphide of iron is no longer attacked by sulphuric acid in consequence of its having become covered with a coating of a sort of basic oxide salt, it may be, so to say, revived by washing it with a strong solution of caustic alkali.

*Magnesium.* London: Pitman. 1865.

THIS little tract contains a very good account of the discovery, present mode of manufacture, and uses of the metal magnesium.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1098. E. Smith and C. Sieberg, Glasgow, "*Improvements in obtaining violet colouring matters*."—Petition recorded, April 20, 1865.

1140. W. E. Gedge, Wellington Street, Strand, "*Improved apparatus for administering nourishment to the sick or infirm*." A communication from B. Mallet, Paris.—April 24, 1865.

1154. J. N. Brown, Handsworth, and T. D. Clare, Birmingham, "*Improvements in paints or compositions for coating and preserving metallic and other substances from oxidation and decay*."—April 25, 1865.



1173. G. T. Bousfield, Brixton, "The manufacture of a new resinous gum or balsam." A communication from B. H. Dods, Melbourne, Victoria.—April 26, 1865.

1183. W. Balk, Emmerberg, Hanover, "Improvements in furnaces used for smelting and melting iron and other metals."—April 27, 1865.

1193. R. Ferrie, J. Murray, and A. Wilson, Paisley, "Improvements in dyeing yarns."

1198. T. White, Camden Town, "Improvements in apparatus employed in the reburning animal charcoal."—April 29, 1865.

NOTICES TO PROCEED.

3256. T. Richardson, Newcastle-upon-Tyne, "Improvements in the manufacture of manures."—Petition recorded December 31, 1864.

3. M. R. Leveson, Bishopsgate Street Within, "An improved method of treating apatite and other mineral phosphates."—A communication from J. Oliver, Estramadura, Spain.

5. J. F. Parker and J. Tanner, Birmingham, "Improvements in the manufacture of oxygen gas, and in treating and economising the residual products of the said manufacture."

9. R. Irvine, Musselburgh, N. B., "Improvements in treating the pitch obtained in, or resulting from the distillation of palm oil and other fats in candle-making."—January 2, 1865.

40. J. E. Vigoulete, Nelson Square, Peckham, "Improvements in the treatment of carbonaceous minerals, and in apparatus for preparing agglomerated fuel."

50. T. Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, "Improvements in treating guano."—January 9, 1865.

73. S. S. Brown, Runcorn, "Certain improvements in the manufacture of lint."

80. W. Clarke, Chancery Lane, "Improvements in preparing or treating wood and other vegetable fibrous materials for the manufacture of pulp for paper."—A communication from Z. Orioli, A. A. Fredet, and P. A. H. Matussiere, Paris.—January 10, 1865.

140. R. A. Brooman, Fleet Street, "Improvements in treating phosphates of lime and salts of potass and soda, in order to fit them for agricultural uses."—A communication from G. Ville, Paris.—Jan. 17, 1865.

538. P. A. le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, "Certain improvements in the treatment of madder and the products obtained therefrom."—A communication from J. Pernod, Avignon, France.—Feb. 25, 1865.

CORRESPONDENCE.

Continental Science.

PARIS, May 15.

IN the absence of any general chemical information, I may pick up a few facts in physiological chemistry which have been brought forward lately, and which I see you have not noticed. The first I may quote are the experiments of MM. Estor and Saintpierre on the seat of respiratory combustion. Where is the oxygen which is taken up by the blood in the lungs used up? In the general torrent of the circulation, the authors state; and by an examination of the blood of the carotid, renal, splenic, and crural arteries, they have shown that the further you go from the heart for the blood the less oxygen you find in it. In the arteries they state that only direct oxidation takes place in consequence of the absorption of the gas, and indirect oxidation from the splitting up of compounds. In the capillary and venous systems, however, the oxidation proceeds to the complete destruction of the compounds.

Dr. Demarquay has ascertained some curious facts by injecting sulphuretted hydrogen into the cellular tissue. He shows that the gas is quickly absorbed, and in a very

short time is eliminated unchanged from the lungs, and may be detected by putting a piece of lead paper under the nose of the animal. The gas, however, cannot be detected in the blood by lead paper, which would indicate that it becomes in some way combined. When a small dose only is injected the elimination is slow, and inflammation of the bronchi and trachea is observed; but with a large dose the animal is quickly killed, and active congestion is observed.

At the last meeting of the Academy M. C. H. Deville presented a French translation of Dr. Percy's "Metallurgy." It has been made by two engineers, MM. Petitgand and Rouna, who have added special information from French sources.

The epidemic in Savoy still attracts some attention. General Morin states that there can be no resemblance between this disorder and the Russian fever, for in St. Petersburg they carefully avoid the use of iron stoves. In connection with the same subject, and the notion that the disease results from the presence of carbonic oxide in the air, M. C. H. Deville reminded the Academy that his brother had shown that red-hot cast iron allowed gases to pass freely.

*The Mysterious Case of Poisoning at Dawlish.*

To the Editor of the CHEMICAL NEWS.

SIR,—I have only just succeeded in obtaining samples of Simpson's rat poison from Messrs. Balkwill and Son, of Plymouth, who appear to be the only agents for this article in the West of England, as I have failed in getting it in most of the chief towns, even Exeter and Bristol; most of the druggists of whom I have inquired informing me that it is very seldom found in the trade. I have also analysed it, and find that the packets contain a very varied, irregular quantity of material; from seven and a-half to thirteen and a-half grains—four packets containing forty-one and a-half grains, giving an average of a little more than ten grains for each powder, if all equally mixed and properly weighed and divided. The mixture consists of arsenious acid, potato-starch coloured by smaltz, and flavoured or scented with some essential oil, probably oil of rhodium. I found ten grains to contain four grains of arsenious acid.

It is, therefore, certain that Mrs. Williams had arsenious acid in her possession, and that she must have taken from six to eight grains, as two empty packets were found by the police in her bed-room. This is a quantity sufficient to kill, but requiring more time probably than she liked; thus accounting for the opening of the third packet.

I greatly regret that there was no opportunity given me of examining the saliva for strychnia, as that would have determined the question whether that poison had also been taken into the mouth. Mrs. Williams had been buried in the interval of the adjournment of the inquest, and I never saw the handkerchief.

It is probable, therefore, that Mrs. Williams purchased all these rat and vermin poisons at Plymouth on her way up to Dawlish from Devonport; and the tracing of the arsenic into her own possession is satisfactory to all parties, as the matter is now fully explained, and all other theories must for ever be set at rest.

I am, &c. W. BIRD HERAPATH.

Toxicological and Micro-Chemical  
Laboratory, Old Market Street, Bristol.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday, May 23, at 4 o'clock, Professor Frankland "On Organic Chemistry." Thursday, May 25, at 4 o'clock, Professor Frankland, "On Organic Chemistry." Friday, May 26, at 8 o'clock, H. Bence Jones, M.D., F.R.S., "On the Determination by the Spectrum Analysis of the Rate of Passage of Crystalline Substances into and out of the Tissues of the Living Body." Saturday, May 27, at 4 o'clock, Alexander Herschel, Esq., "On Meteorology."



## MISCELLANEOUS.

**Pharmaceutical Society's Conversazione.**—On Tuesday evening the annual *conversazione* took place. It was, as usual, very numerously attended by members of the medical profession as well as pharmacutists. A number of interesting and beautiful objects were distributed about the rooms, and gave much pleasure to the visitors. Mr. Stewart Harrison's self-acting preserver valve, for the extinguishing of fires, was explained and shown in operation, and Lenoir's patent prize medal gas-engine, of half-horse power, was at work during the evening. Carre's ammonia ice-making machine was also in operation during the evening. An improved dispensing counter (a very complete and convenient arrangement), designed by Mr. Joseph Ince. Specimens illustrating the manufacture of aniline dyes, including a set of products, with their proportions, from the common coal yielding the tar to the solid dye; also specimens of silk and wool dyed of various colours. Some of the dyes were beautifully crystallised, and of great value, from Messrs. Simpson, Maule, and Nicholson. (These specimens were illuminated with the magnesium light with beautiful effect.) Specimens of pure crystallised carbolic and picric acids, dyeing materials obtained from this source, and dyed silk illustrating the colours produced, from Messrs. Crace Calvert and Co. Specimens illustrating the manufacture of iodine and other products from seaweed, by Stanford's process, as carried out by the British Seaweed Company (Limited), from Mr. E. C. C. Stanford. Specimens of new organic polarising compounds containing iodine, described at the last meeting of the Chemical Society, from Mr. W. A. Tilden. Large platinum still, of about 100 gallons capacity, and of the value of 2000*l.*, such as is used in the manufacture of oil of vitriol; fine specimens of pure distilled magnesium, a platinum pyrometer, small platinum still, specimens of gold and its compounds, &c., &c., from Messrs. Johnson and Matthey, who also exhibited the magnesium light in the lecture theatre. A variety of philosophical apparatus, from Mr. John Browning, 179, Strand, including the following:—A new aneroid barometer, showing a movement of three feet for one inch of the mercurial barometer; the Herschel-Browning spectroscope, arranged for observing the spectra of the stars; star spectroscopes as used by Huggins; large model spectroscope with eight prisms; five-guinea spectroscope; objects shown with spectroscopes; micrometric apparatus in aluminium, &c. Self-acting electrical alarum, for giving notice of the escape of coal-gas, from Mr. Broughton. Berthon's improved telescope stand, and apparatus for polarised light, from Messrs. Horne, Thornwaite, and Co. Mercury pump with vacuum tube and induction coil, showing stratified electrical discharges in vacuo, by Mr. Ladd. Improved ophthalmoscope and microscopes, from Messrs. Smith and Beck. Unique collection of statuettes in amber, from Dr. Attfield. Oil-lamp furnace, from Mr. Griffin. Astroscope, stereoscopes, microscopes, new photographic manipulating apparatus, from Messrs. Murray and Heath. Improved microscope condenser and microscopes, from Mr. Highley. Electro-magnetic engine (in motion), and other philosophical apparatus, from Mr. How. Dr. Maddox's microphotographs, manufactured by Mr. How, were shown in the secretary's office during the evening by Mr. Jones. Minerals and fossils, from Mr. Gregory. Specimens of dried ferns and seaweeds, from Mr. Jardine. Busts, pictures, prints, and antiquities, from Messrs. Hill, Bird, Butler, Campkin, Vokins, and Bremridge. Patent flexible diaphragm for the preservation of liquids liable to be injured by exposure to the atmosphere, and patent elastic valve, from Mr. S. Bourne. Simple needle telegraph, from Mr. T. Boverton Redwood.

**Select Committee on Pharmacy Bills.**—The Select Committee of the House of Commons commenced its sittings on Thursday last. On that day Dr. A. S. Taylor and Mr. Simon were examined. The evidence of the former was mainly in support of a clause restricting the sale of the more dangerous poisons. Mr. Simon's evidence was to the same effect. In the course of his examination he said that he could not see that an examination as to ability was of so much importance, because no Act would do away with carelessness. He did not believe that ignorance could be imputed to those who made mistakes in retailing medicines or compounding prescriptions. At the same time he advocated a high class education for dispensers. As soon as the evidence is printed, we shall return to the subject.

**Direct Formation of Polychromatic Aniline.**—This is the subject of a Belgian patent by M. Rave. He takes five parts of commercial hydrochloric acid and one part of colourless aniline, mixes the two, allows the mixture to cool, and then stirs in one part of peroxide of manganese and applies a great heat. When the mixture has taken a greenish-blue tint, it is ready for use. The peroxide of manganese in this part of the process may be replaced by other oxidising agents. The inventor next prepares a solution of chloride of chromium by dissolving one part of bichromate of potash in five parts of hydrochloric acid. In dyeing, the inventor first pours into the bath a variable quantity of the polychromatic aniline, according to the shade of colour required, immerses the wool, and applies heat. The wool is then withdrawn and placed in a bath with a small quantity of the chloride of chromium, whereupon the colour darkens, and an equal shade is produced.

**Sorel's Cement for Stopping Teeth.**—The author prepares a light oxide of zinc by moistening the ordinary oxide with nitric acid, and then igniting it. Oxide so prepared he makes into a soft paste with a solution of chloride of zinc having a specific gravity 1.9 or 2.0. The soft mass in a few minutes acquires great hardness, which it preserves for many years. To imitate the colour of the teeth the mixture may be made grey with the least trace of carbon; it is sufficient to hold the pestle with which the mixture is made over the gas for a moment. If a yellow tint is required, a trace of sulphide of cadmium may be employed.—*Neues Repertorium*, bd. xiii., s. 552.

**The Reciprocal Hygroscopicity of Chloride of Calcium and Sulphuric Acid.**—Gotz placed weighed quantities of these two bodies in separate vessels and left them side by side in a close tube for several months. In one experiment he used quite dry, and in another moist chloride of calcium. In the former case the two bodies only removed some moisture from the air; in the second the sulphuric acid removed nearly two equivalents of water from the chloride of calcium. The author concludes that solution of chloride of calcium containing 73.1 CaCl and 26.9 HO, and sulphuric acid with 74.34 SO<sub>3</sub> and 25.66 HO are equal in their desiccating action. He remarked that after exposure together a trace of sulphuric acid is to be found in the chloride of calcium, which he ascribes to the tension of the hydrated acid. [Was the chloride pure?]  
—*Buchner's Repert. für Pharm.*, Bd. 13, 3, s. 104.

## ANSWERS TO CORRESPONDENTS.

*W. M. B.*—The patent, we believe, is still valid.

*Phenylamine.*—No important industrial application has yet been found for naphthalene. The dyes have failed for want of brilliancy.

*D. H. J.*—A comparison of the tinctorial value of the various dyes with some of known purity is the best plan for ascertaining their commercial value.

*M. W.*—We are expecting the article from the author.

*Cotton Seed Oil.*—A correspondent wishes to know a test for this oil when used as an adulterant.



## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.\**

(Continued from page 174.)

**II. Terbia and Yttria.**—The earths remaining after the extraction of erbia, as directed in a former memoir (*ante*, p. 173) still contain a small quantity of erbia, from which they should be freed as much as possible. This is effected by a new series of partial precipitations, followed by methodical solutions in a diluted acid, and finally by the use of potash. This method is not perfectly strict, because erbico-potassic sulphate is slightly soluble in a liquid containing sulphate of potash; however, the proportion of erbia thus remaining in the mixture may be reduced to three or four thousandths.

I wished to substitute, for the precipitations by binoxalate of potash, the process recently proposed by MM. Deville and Damour for the relative estimation of the lanthanum and didymium contained in parisite.† By exactly following the directions of these clever chemists I obtained, on the one hand, erbia, with a small quantity of its congeners, in the form of an insoluble basic nitrate, while the greater part of the yttria and terbia remain in solution. After having washed the subnitrate until it began to pass through the filter, I calcined it, and transformed it into double oxalate; this I treated by water acidulated with a fifth of sulphuric acid, which dissolved the two other bases, leaving erbia in a sufficiently pure state. The results thus obtained are perhaps less exact than those obtained by the old method, but there is, on the other hand, a great saving of time.

Yttria purified by one or the other of these methods, and re-dissolved in an acid, gives, with binoxalate of potash, precipitates variably soluble in diluted sulphuric acid; the most soluble contain yttria, the others terbia. Roughly separated in this way, then separately dissolved in and again partially precipitated, &c., these two earths may after a time be obtained sufficiently free from each other to allow the study of their distinctive characteristics.

Hydrated terbia forms a white gelatinous precipitate, remaining in this state during desiccation, but becoming yellow after being long calcined. In the anhydrous state, and according to the process by which it has been prepared, this earth offers the same differences of colour as does erbia, but only in the lighter tints. This colour must belong to the terbia itself; the presence of the trace of erbia, from which it is almost impossible to free it, is insufficient to account for the colour.

Calcined for some time at a white heat, or better, heated to a dull red in a current of pure dry hydrogen, terbia assumes, like erbia, a milk-white colour; the quantity of water produced in the latter case is barely appreciable. Its salts have always an amethyst-rose tint, which generally remains after solution, and is found in a less degree in the solid salts of erbia, and still less in those of yttria.

Diluted terbic nitrate is rose-coloured; it becomes darker and darker while concentrating, but without approaching violet, as does didymium. Heated slowly and carefully it loses all its water, fusing into a glass, which preserves its colour, and finally decomposes towards 500°, leaving a basic salt, from which a high temperature expels all the acid.

If not in too dilute solution the salts of terbia show, in the spectroscopic, at least two absorption rays of equal intensity; one in the yellow part, near D, and the other in the green; they coincide with two bands of didymium; but when equal in concentration they are narrower.

Even after exposure to great heat terbia combines readily with acids, forming compounds with a sweet and astringent flavour; this base is more energetic than oxide of didymium; it expels ammonia from its salts even when cold, but especially when hot.

There is, to my knowledge, no other method for ascertaining to what extent terbia is freed from yttria; but if we concentrate very slowly, with gentle heat, a solution of yttriferous terbie sulphate acidulated with sulphuric acid, the crystals successively deposited have a smaller and smaller atomic weight, until finally they consist only of nearly pure sulphate of yttria. Starting with this fact, I have described, and considered as of the terbia type, that of which the sulphate gives, by crystallisation in three portions, products identical in composition.

More recent experiments have shown me that the atomic weight of terbia should be given as lower than 571, which number I deduced from my previous analyses; it is, however, greater than that of yttria.

In colour terbia resembles pure ceroso-cerie oxide; but is distinguished from it by its ready solubility in even diluted acids, its reactions with the blow-pipe, the colour of its salts, its atomic weight, and finally by its absorption spectrum.

Terbic salts resemble those of didymium in their colour and their dark lines; they are distinguished from the didymium salts by the colour and the equivalent of their base, and by the absence of the seven lines and bands characteristic of didymium.

Chemically terbia may easily be confounded with erbia, but the spectra of these two earths are very different.

In short, I believe I may consider the existence of terbia as established; its composition deduced from the isomorphism of its sulphate with that of didymium will then be represented by  $\text{TrO}$ , terbium should have for symbol  $\text{Tr}$ , and not  $\text{Te}$  (on account of tellurium), as it is sometimes erroneously given.

In Mosander's opinion terbia should be white, but it seems to have always been obtained yellow, and he also holds its distinctive characteristic to be the property of efflorescing at +50°C. possessed by its sulphate. I do not agree with this; terbic sulphate does not appear to me more efflorescent than that of yttria. Perhaps we did not experiment upon salts of the same degree of hydration; this appears to me all the more probable from the fact that I once obtained some indistinct crystals falling into powder on the filter paper, and corresponding in composition to the formula  $\text{TrO} \cdot \text{SO}_3 + 3\text{aq}$ . As I have said before, M. Berlin considers terbia as a simple mixture of erbia and yttria; the properties I have described seem to me incompatible with this opinion. M. Bahr seems still undecided as to the existence or non-existence of terbia.

**Yttria.**—In the order of basic energy this earth is the first of the group. From having imperfectly purified it, I described it in my first memoir as of a very light yellow colour. This is erroneous; whether anhydrous or hydrated,‡ yttria is perfectly white; like the other two, it carbonates easily, decomposes ammoniacal salts, combines with all acids, with disengagement of heat if they

\* *Bibliothèque Universelle et Revue Suisse*, xxii., 30 65.

† *Comptes Rendus*, lix. 270. *CHEMICAL NEWS*, vol. x., p. 230.

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‡ M. Popp is wrong in regarding the whiteness of yttria as accidental, and attributing it to a mixture of potash or lime.



are concentrated, and gives syrupy solutions. Its solutions have not the property of showing the spectrum of absorption.

Its white colour can cause it to be confounded only with lanthanic oxide; these two bases are distinguished by their crystalline form and the centesimal composition of their simple sulphate; moreover, yttrico-potassic sulphate is soluble in pure water, and still more so in water containing sulphate of potash, which is not the case with the salt of lanthanum.

**Estimation of Gadolinite Earths.**—In the analysis of double salts with a fixed alkali base, and yttria (or erbia and terbia), the best method consists in precipitating the earth by caustic potash, with all the precautions recommended in Rose's "Chimie Analytique." If the salt is simple, or combined only with an ammoniacal salt, it is better to avoid heating and to replace the potash by oxalate of ammonia. The liquids should be as neutral as possible, on account of the solubility of earthy oxalates in diluted acids. The precipitate though light is easily collected and washed; it readily passes through the filter after water has been once or twice passed over it, but this inconvenience is obviated by the addition of a little ammoniacal nitrate or chloride. Calcination must be effected in an open crucible, because all the oxalates of this group leave carbides when decomposing out of contact with oxygen, as is shown by the blackness of their residue. When after a few minutes the earth becomes white or yellow, the cover is replaced and the crucible heated to expel the last traces of carbonic acid. In very exact researches it is necessary to eliminate the small excess of oxygen retained by the earth, to effect which a current of hydrogen must be passed in the usual way into the crucible, through a tube traversing the lid. The results obtained by this method are rigorously exact.

Having, as it appears to me, positively established the individual existence of the three earths of gadolinite, and thus confirmed the excellent results obtained by Mosander, it remains for me to make known several salts, the study of which is quickly achieved, and to determine more exactly the atomic weight of erbium, yttrium, and terbium. This must be the subject of some future memoir.

(To be continued.)

### A New Method for Preparing Benzoic Acid, by MM. P. and E. DEPOULLY.\*

THIS process is founded on the transformation of phthalic into benzoic acid.

The division of phthalic acid into benzoic and carbonic acids was foreseen by Gerhardt; when he placed phthalic acid and naphthaline in the benzoic series, he considered that this acid was to benzoic acid what oxalic is to formic acid. (Gerhardt, "Chimie Organique," iii., 413.)

M. Berthelot (Chimie Organique Fondée sur la Synthèse, i., 348), speaking of the complete division of phthalic acid into benzine and carbonic acid, expresses himself thus in a note:—"Were the decomposition arrested half way, benzoic acid would doubtless be produced."

M. Dusart has since, but without success, endeavoured to effect this division; but by distilling a mixture of phthalate of soda, oxalate and lime, he has obtained, among other products, small quantities of hydride of benzoil (Comptes Rendus, 1862, lv., 448).

We prepare phthalic acid by means of naphthaline, and we transform it into salt of lime.

We mix an equivalent of neutral phthalate of lime bicalcic phthalate, with an equivalent of hydrated lime, and maintain it for several hours at a temperature of from 330° to 350°, not allowing free access of the air.

The salt will then be entirely transformed into benzoate and carbonate of lime, according to the equation—



We extract the benzoate of lime by water, concentrate the liquids, and precipitate the benzoic acid.

### Solution of Some Metallic Oxides in Fused Caustic Alkalies,† by M. STANISLAS MEUNIER.

SMALL portions of binoxide of mercury thrown into potash, maintained in a state of fusion, dissolve with the greatest ease. The solution is accompanied by no gaseous disengagement, and it gives a colourless liquid if the materials are perfectly pure, more or less greenish if they are impure. The quantity of mercuric oxide which will dissolve in a given weight of potash is very considerable, but cannot be precisely determined. In proportion, in fact, to the concentration of the solution, its temperature rises, and oxide is abundantly disengaged; from that time any binoxide which is added only replaces that which is each moment destroyed. As the concentration increases, the mass acquires a yellow tinge, and takes the consistence of less and less fluid oil.

By cooling, the solution becomes coloured, and finally assumes a tint depending upon the conditions under which it is produced. Washing in cold water gives a powder corresponding in colour to the mass from which the powder proceeds, and the composition of which varies with the colour.

A constant product may be obtained by the following process:—Heat some potash in a silver capsule, and before it is quite fused, throw in a quantity of mercuric oxide too small to saturate the alkali. The oxide then gradually dissolves at a temperature below 400°. Soon, the whole of the potash being melted, the last particles of oxide disappear; when the heating must immediately cease, and the cooling be very slowly effected. Under these circumstances, the mass takes a violet-brown colour. When quite cool, treat it by a small quantity of water, just sufficient to dissolve the excess of potash, and a violet powder is thus obtained, mixed with a much lighter greenish grey powder, which, on account of its lightness, is easily separated by simple decantation. Then dry the two powders on porcelain; they constitute combinations of mercuric oxide and potash, the composition of which I have not yet accurately determined. Examined with the microscope, the violet compound seems to be formed for the most part of tawny red transparent crystals. The greenish compound is amorphous.

The violet body is decomposed, but not completely, by prolonged washing. After boiling four hours in distilled water, this body still contains an appreciable quantity of potash.

By reason of its instability certain precautions are necessary to separate the compound from potash. It is advisable, for instance, to wash it in anhydrous alcohol instead of water. Nevertheless, it is better to leave the potassic mass to deliquesce and to close the operation as soon as possible. The only drawback to this process is that it renders it difficult to separate completely the above-mentioned greenish compound.

If, instead of being slowly cooled, the solution of binoxide of mercury in potash is thrown drop by drop into

\* Comptes Rendus, lx., 456. 65.

† Cosmos, i., 353. 65.



cold water, a yellowish precipitate is produced, which might at first sight be mistaken for yellow oxide of mercury, but which, in spite of washing, always contains potash. In its properties it much resembles the greenish compound. It is also reproduced by maintaining the solution for a long time in fusion.

All these reactions take place equally with yellow oxide of mercury and with red oxide.

Fused caustic soda has, with respect to binocide of mercury, the same solvent properties as potash. By operating with the above precautions a compound is obtained in the form of an orange-brown crystallised powder.

Protoxide of bismuth dissolves very readily in fused potash and soda.

It thus gives two compounds very rich in alkali, which I am now engaged in studying. They are in the form of a greyish white crystallised powder. Great precautions should be taken in preparing them, for, at a high temperature, in presence of melted alkalies, bismuth peroxidises very readily. I believe that bismuthates of potash and soda may be easily prepared in this way.

Oxide of cadmium also dissolves in fused potash and soda, giving grey and amorphous compounds, probably corresponding to alkaline zincates.

## TECHNICAL CHEMISTRY.

### *Galibert's Respirators.*

THERE are unhappily many occasions on which men have to enter a suffocating or poisonous atmosphere, and many fatal accidents have ensued. The apparatus we now describe has been devised to supply men so circumstanced either with a reservoir of pure air from which they can respire for a longer or shorter time, or to keep up a continuous supply by free communication with the external air. The former apparatus (Fig. 1) is adapted for firemen and others who may at times be required to enter and remain for a time in a suffocating atmosphere; and the latter (Fig. 2.) for well-sinkers, miners, or sewer-men who may be compelled to work for a long time in the presence of a poisonous gas. A complete idea of the apparatus will be given by the accompanying figures, assisted by the following description:—

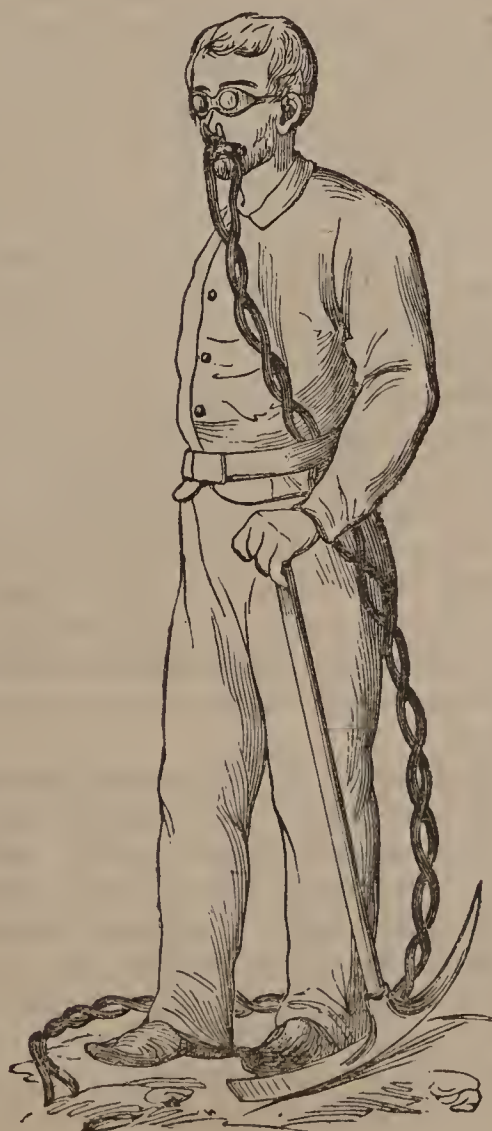
It is composed of three parts,—first, a piece of horn, or ivory, of the form and dimensions of the human mouth when open, pierced with two holes; second, two caoutchouc tubes of a proper length, communicating with the holes in the piece of horn or ivory; and thirdly, a nose pincher for preventing respiration through the nose. The apparatus is used as follows:—The pincher being applied to the nose, the mouth-piece is placed in the mouth, where it is held by slight pressure of the teeth. The lips, by surrounding the mouth-piece, prevent communication between the chest and the air in which the operator is at work, so that he can only breathe the air brought by the tubes, the other ends of which are in the open air. The tongue acts the part of a valve, opening and closing alternately, the holes communicating with the tubes for inhaling and exhaling air. This alternate movement of the tongue is exceedingly easy, and is performed almost instinctively after a few minutes' practice. On placing the mouth-piece between his teeth, the operator closes the right hole with his tongue; he then draws air into his lungs by the left tube; he next moves the tongue, without pressing it, over the left hole, and then expires or breathes out vitiated air by the right tube. There are thus no mechanical parts in

this apparatus; the lungs fulfil the functions of a suction and force-pump, and the tongue acts as a double valve. As smoke and gases affect the eyes, the inventor also provides special glasses, or even surrounds

FIG. 1.



FIG. 2.





the head with a hood. The india-rubber tubes, as we have said, are sometimes in communication with the external air, and sometimes with a reservoir, as in Fig. 1. It was this latter form of the apparatus which we saw used at the Polytechnic a week ago. Provided with it a man entered an apartment which had been extemporised by extending canvas over a wooden frame. In this chamber a mixture of cotton waste and nitre was ignited, generating a dense and suffocating smoke; a man was, however, able to remain in such an atmosphere without discomfort for twenty minutes, and so demonstrate the perfect adaptation of the apparatus for its purpose.

## PHARMACY, TOXICOLOGY, &c.

### *Alleged Poisoning by Oil of Bitter Almonds.*

A CASE of poisoning near Maidstone, which we find reported in the *Chemist and Druggist*, deserves some notice as of interest to toxicologists. A lady purchased, it is said, some essential oil of bitter almonds to scent pomatum, made use of some for the purpose, and left the bottle on the kitchen table, some time, it would appear, before the servants' dinner hour. The exact hour is not stated, but we may presume it was before the middle of the day. Finding the bottle on the table, the cook took it up and tasted its contents. She stated that she merely put the bottle to her lips, but did not swallow any of the contents. It tasted bitter, and she ate a piece of bread to take the taste out of her mouth. She saw the deceased (a page-boy, aged thirteen) take up the bottle and put it to his lips, and she took it away from him. The boy told her he did not swallow any of the contents. Shortly after this the servants had their dinner, and an hour afterwards the cook was taken ill, but the boy went about his work as usual. A medical man who was sent for found the cook unconscious; was told that she had swallowed some oil of bitter almonds, so he administered some brandy, and she soon rallied. At this time there was nothing the matter with the boy. The medical man on leaving the house after attending to the cook met the boy out with his master in the carriage. In the course of the evening the lad was taken ill, and the doctor was again sent for. He found the deceased insensible, almost pulseless, and his teeth so tightly closed that he had great difficulty in getting a piece of cork between them. Brandy was administered freely, but without success. He was carried upstairs about seven o'clock in the evening, and died at a quarter past eleven. At the inquest the medical man stated, "that he had no doubt the deceased died from the effects of having taken oil of almonds. If the boy had taken a larger quantity his stomach would have rejected it at once, and it might not then have got into his system. He should say the deceased and the cook must have taken a teaspoonful each." In the last words spoken by the boy he denied having swallowed any.

In a note to the report our contemporary says—"We have been informed that the poison was not genuine oil of almonds, but a factitious oil," and it must be quite clear to any one acquainted with the subject that the poison was not essential oil of bitter almonds. Everybody knows that the poison in this oil is prussic acid; and we believe we may state with truth that there is not a case on record in which the symptoms of poisoning by prussic acid have been delayed for the length of time which elapsed in this case. All the circumstances lead

to the suspicion that the poison taken was *nitrobenzole*, the dangerous properties of which body are not sufficiently known. It may be, indeed, that this more dangerous poison was sold in innocence as oil of bitter almonds not containing prussic acid.

The case of this boy bears a considerable resemblance—so far, we ought to say, as we can gather from the report of the inquest—to the case of a lad who died from the effects of a few drops of nitrobenzole which he took by accident at a chemical manufactory. In that case four or five hours elapsed before the fatal symptoms came on, and the duration of the symptoms was about the same in each case.

In the interest of science we must hope that this case will receive further elucidation, both from the druggist who sold the poison and the medical man who attended the deceased.

## PHYSICAL SCIENCE.

### *On the Construction of the Spectroscope, by LEWIS M. RUTHERFORD.*

I KNOW of no good substitute for bisulphide of carbon as the dispersive agent in the spectroscope. Flint glass, besides being expensive when in larger masses and of good quality, possesses but half the dispersive power, and the specimens of the denser glass which I have seen tarnish so rapidly, and have so high an index of refraction, as to be practically useless. Having devoted much time to the construction and management of bisulphide of carbon prisms, it is quite possible that the results of my experience may be useful to those who may wish to fit up a spectroscope with such prisms, and perhaps I shall best attain the object by describing my own instrument.

The two principal telescopes are provided with objectives of 1.6 inches aperture and 19 inches focal length. The slit or collecting telescope has but one motion about a vertical axis at the side of the platform and just in front of the objective, enabling it to command all parts of the platform. The observing telescope has two motions—one about the central axis of the instrument, and the other about a second vertical axis, which, by means of a slide capable of being clamped, can be placed under the last surface of any prism on the platform; thus commanding by one motion the whole spectrum.

Before the slit is a prism for the comparison of different spectra, and the observing telescope is provided with eye-pieces of various powers. The first circuit consists of six prisms, which are of glass, faced with plates of glass, cemented with glue and molasses. These are each of about the angle of  $60^\circ$ , and present an aperture of  $2.9 \times 1.8$  inches. The faces to receive the glass are carefully ground to a flat surface, and the glass quite thick and free from veins has been selected with reference to the flatness and parallelism of the sides.

Since, however, it is scarcely possible to find glass with parallel surfaces, care has been taken so to place the glass that the inclination of its faces is perpendicular to the axis of the prism. After grinding the prisms the bases were so adjusted by filing that the refracting surfaces are rigidly perpendicular to the plane of the platform. This once done removes all necessity for foot-screws, which complicate the prisms, and add to the expense.

The surface to be glazed was washed with an alkaline solution to remove all grease, and then in dilute nitric acid, finally washed in pure water, and allowed to dry spontaneously. After being warmed, the prisms were



so placed that the surface to be glazed was uppermost, and in a horizontal position: the glass, having been cleaned after the manner of a plate for photographic purposes, also warmed, and both surfaces to be in contact, dusted with a fine camel's hair brush, was placed in position upon the prism, a hot and fluid mixture of glue and molasses was then applied with a fine brush around the edges of the glass, whereupon a uniform and very thin film of the cement was introduced between the glass and the prism by capilarity. The prism was left untouched until the cement had hardened so as to admit of being removed and placed glass downwards for at least a day, when the next surface was treated in like manner. After the expiration of another day, I generally put on another coat of cement, much thicker in consistency than the first. In five days more the prism was ready to be filled through an orifice in the top, to which is fitted a ground stopper, which is rendered perfectly tight by a little molasses. It may be thought that my description is needlessly particular, but I have mentioned nothing which experience has not shown to be necessary to the permanence or performance of the prism.

I soon discovered that after I had made a good prism its performance would be uncertain, and I finally traced the difficulty to a want of equal density in the bisulphide of carbon, and this peculiarity I have observed not only in the fluid of commerce, but quite as much so in that specially redistilled for the purpose. The fact of this unevenness of density is found in two ways. If a good prism, which, with a high power, refuses to define the soda line (a more stringent test than solar lines) is violently shaken, and then placed in position, it will, for a few minutes, define beautifully, but gradually settle into its former condition. By covering the aperture of the prism, except a small portion of the upper part, and bisecting the soda line with a spider's web in the eyepiece, all parts of the instrument being clamped, then covering all but the lower portion of the prism, it will be found that the soda line has been carried to a notable extent toward the violet end of the spectrum.

This want of homogeneity in the bisulphide of carbon is entirely different from the disturbance of density by thermal variations. It is a permanent feature of some specimens of the fluid, and is most observable when the prism has been longest at rest in equable temperature. I have one such prism filled nearly two years since, which defines beautifully for a short time after being well shaken, but soon returns to a poor condition. The difference between the indices of refraction of the upper and lower strata is quite a measurable quantity. My mode of overcoming this obstacle is to filter several pound bottles of the bisulphide of carbon into a long glass jar, having a faucet at the bottom and a ground stopper at the top. After remaining undisturbed two days the liquid arranges itself according to its density, and I fill the prisms from the faucet, being careful not to shake the jar. Careful and repeated measures give for the index of refraction of the soda line with the prism first filled from the bottom 1.62376, and with the ninth prism, filled with the fluid near the upper portion of the jar, 1.62137.

In order to obtain fine definition it is necessary that the prisms should be placed at the angle of least deviation for the ray under observation. To make the adjustment with several prisms, or to change it when made, is so barbarous and troublesome a task as almost to amount to a prohibition of the use of a powerful battery for practical and extended investigations. To remedy this evil I have devised and executed a mode by which

I effect the adjustment of all the prisms by one motion of a milled head. Upon the glass plate which forms the platform of the instrument, and in the centre of the system, is cemented a brass plate, in a cavity of which revolves without shake a pinion provided at the top with a milled head. The prisms are all hinged together at the corners, and from the back of each projects at right angles a brass bar, provided with a slot, which embracing the revolving standard accurately, retains each prism in such a position that, whether nearer or more distant from the centre, its back is always perpendicular to the radius connecting it with the centre of the standard. The slot of the third prism is provided with teeth which gear into the pinion, so that by turning the milled head this prism is forced to approach or depart from the centre; but from the construction this cannot take place without imparting a similar motion to each of the other prisms, and thus at will their backs are made tangents to a larger or smaller circle, which is the adjustment sought.

This mechanism is capable of adjusting six or any smaller number of equi-angled prisms. The outer spiral, when more than six are used, must be adjusted by hand.—*American Jour. Science and Arts*, vol. xxxix., No. 116.

#### On a New Thermo-Element, by M. S. MARCUS.

THE author has given the following account of the properties and construction of his new thermo-element:—

1. The electro-motive force of one of the new elements is  $\frac{1}{25}$ th of that of Bunsen's element, and its resistance is equal to 0.4 of a metre of normal wire.

2. Six such elements can decompose acidulated water.

3. A battery of 125 elements disengaged in a minute 25 cubic centimetres of detonating gas. The decomposition took place under unfavourable circumstances, for the internal resistance was far greater than that of the interposed voltameter.

4. A platinum wire half a millimetre in thickness introduced into the circuit of the same wire is melted.

5. Thirty elements produce an electro-magnet of 150 pounds lifting force.

6. The current is produced by heating one of the junctions of the elements and cooling the second by water of the ordinary temperature.

To construct this battery it is necessary, on the one hand, to procure two electromotors suitable for a thermo-element, and, on the other, to have such an arrangement of the elements and of the means for heating and cooling as will ensure as favourable a result as possible. The former constituted the physical, the latter the constructive part of the problem.

In solving the first part of the problem, it was the author's endeavour—

a. To use such thermo-elements as are constructed of metals as far apart as possible in the thermo-electric series, and

b. Such as permit great differences of temperature without using ice, which is only practicable if the bars possess as high fusing points as possible.

c. The material of the bars must not be costly, and the bars themselves must be easily constructed.

d. The insulation used for the elements must be able to resist high temperatures, and must possess sufficient solidity and elasticity.

As neither the usual bismuth antimony couples nor any combination of the other simple metals satisfy these



conditions, M. Marcus availed himself of the circumstance that alloys in the thermo-electric pile do not stand between the metals of which they consist, and was thereby led to the following alloys, which completely satisfy the above requirements:—

For the positive metal—

10 parts of copper,  
6    "    "    zinc,  
6    "    "    nickel.

An addition of one part of cobalt increases the electro-motive force.

For the negative metal—

12 parts of antimony,  
5    "    "    zinc,  
1 part of bismuth.

By repeated remelting the electro-motive force of the alloy is increased.

Or he used a combination of argentane (known as alpacca from the Triestinghofer Metal Manufactory) with the above negative metal; or an alloy of

65 parts of copper,  
31    "    "    zinc,  
as positive metal, and an alloy of  
12 parts of antimony,  
5    "    "    zinc,  
as negative metal.

The bars are not soldered together, but bound by means of screws.

The positive metal melts at about  $1200^{\circ}$  C., the negative at about  $600^{\circ}$  C.

As in this element it is only the heating of the positive metal which influences the development of electricity, the arrangement has been made that only this is heated, while the negative metal receives heat by conduction. By this arrangement it is possible to apply temperatures of even  $600^{\circ}$ , and consequently to attain greater differences of temperature.

An interesting illustration of the conversion of heat into electricity is the fact that the water which is used for cooling the second point of contact of the element becomes warm very slowly as long as the circuit is closed, but pretty rapidly if it is open.

The thermo-pile in question was constructed with a view to being used with a gas-flame. The individual elements consist of bars of unequal dimensions. The positive electrical bar is 7" long, 7" broad, and  $\frac{1}{2}$ " thick; the negative electrical bar is 6" long, 7" broad, and 6" thick. Thirty-two such elements were screwed together, so that all positive bars were upon one and all negative on the other side, and thus had the form of a grating. The battery consists of two such gratings, which are screwed together in a roof shape, and are strengthened by an iron bar. As an insulator between the iron bar and the elements, mica was used. Besides this, the elements, where they came into contact with the cooling water, were coated with soluble glass. An earthen vessel filled with water was used for cooling the lower contact sides of the elements. The entire battery has a length of 2 feet, a breadth of 6 inches, and a height of 6 inches.

M. Marcus communicated further that he had constructed a furnace which was intended for 768 elements. They represent a Bunsen's zinc carbon battery of thirty elements, and consume per diem 240 pounds of coal.—*Sitzungsbericht der Akademie in Wien*, No. 8, 1865.—*Philosophical Mag.*, vol. xxix., No. 197.

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"On the Food of Man in relation to his Useful Work." By LYON PLAYFAIR, C.B., LL.D., F.R.S.

(Continued from page 235.)

20. Nothing is better established in physiology than that muscular activity is dependent on a free supply of arterial blood to the muscles. When a ligature is applied to a large arterial trunk, the action of the voluntary muscles depending on that vessel is either wholly or partially arrested, at least until the collateral circulation is developed. Thus when the abdominal aorta is tied in animals, their hind legs can scarcely be dragged along (Segalus).¶¶ Such experiments only prove that a free supply of arterial blood to the muscle, to promote its transformation and to restore its waste, is necessary for the production of muscular action. Anything that interferes with the oxidising influence of the blood upon the substance of the muscle affects the power of movement. In the cerulean disease, when venous and arterial blood become mixed, the patient shows both indisposition and inability for muscular exertion. Like difficulty is observed in the thin air of mountain tops, until the lungs become suited to it. Certain substances which retard the oxidation of phosphorus or phosphuretted hydrogen, even in the presence of oxygen (Graham), such as ether and chloroform, seem to act in a like way on the tissues of an animal, by arresting muscular effort. The proof that there is diminished oxidation in such cases is found in the presence of sugar in the urine. The wayward gait of the drunkard under the influence of alcohol is probably the result of a similar obstacle to change.

Gustav von Liebig\* has demonstrated that the oxidation of tissue is quite essential to muscular irritability, which ceases when the access of oxygen is prevented, and is again manifested when it is supplied. Scelkow's† experiments on the gases of the blood are particularly interesting in this point of view. Arterial blood contains 17 vols. of oxygen, and is reduced to 8 vols. in coursing through a muscle at rest, and to between 1 and 2 vols. when the same muscle is in action, the volume of carbonic acid augmenting from 24 to  $34\frac{1}{2}$  at the same time. These experiments prove clearly that oxidation and contemporaneous production of carbonic acid attend the transformation of tissues, a fact which other physiologists had shown with less numerical precision formerly. Thus Matteucci,‡ in confirming the fact that muscular contraction is dependent on the presence of oxygen, showed that the evolution of carbonic acid is proportional to the amount of contraction, a result which has been confirmed by Valentin.§ We need scarcely adduce proofs that the oxidation and production of carbonic acid proceed simultaneously in the substance of the tissue and not in the blood, for as long as the muscle is contractile, after it has been cut off from the blood, the same changes go on. Again, in insects which have no true blood, carbonic acid is produced by muscular activity (Newport).|| Valentin¶ observed that when muscular contraction takes place a greater volume of oxygen is absorbed than of carbonic acid evolved, a result to be expected when we know that hydrogen is oxidised and urea is formed. Helmholtz attempted to follow the changes in a contracting muscle, and found evidence of

¶¶ *Journ. de Phys.*, 1824.

\* Inaugural Abhand. Giessen, 1853.

† *Sitz. Wiener Acad.* 1862.

‡ *Comptes Rendus*, xlii. 648.

§ *Müller's Archiv.* 1845. S. 72.

|| *Phil. Trans.* 1836.

¶ *Archiv. für Heilkunde*, xiv. 431.



increasing lactates, but could find no diminution in the fat contained in it, a fact of great significance, as we shall see hereafter. Brown-Séquard\*\* by producing a circulation of arterial blood in the body of an animal which had assumed cadaveric rigidity, showed that muscular relaxation and contractility was restored and preserved for a long time, the blood issuing as venous; and he further proved that the elongated condition of muscles required the presence of oxidised blood. I have made experiments along with Mr. Turner, the Demonstrator of Anatomy in the University of Edinburgh, to ascertain whether oxygenated water (peroxide of hydrogen), or a solution of permanganate of potash, would cause relaxation in the muscles of rabbits after *rigor mortis* had set in, as Richardson found. In four rabbits these supplies of oxygen had no effect whatever, either in preventing the access of *rigor mortis* or in relaxing it. I believe, therefore, that this relaxation is not due merely to the oxidation of the muscle, but to its nutrition by the arterial blood, which feeds it while it removes the effete matter. It will be obvious from the tenor of my remarks, although I am unwilling to complicate the present question by a theory, that I agree with Draper†† and others, in considering the contraction of a muscle due to a disintegration of its particles, and its relaxation to their restoration, agreeing also with Dr. Radcliffe‡‡ as to the active state of the relaxed muscle and the exhausted state of the contracted, without assenting, however, to his torpedo discharges as the causes of these states.

21. All these facts prove that transformation of the muscle through the agency of oxygen is the condition of muscular action. Most likely intermediate products are formed before the final forms of carbonic acid and urea are reached. If these graduated changes take place in the muscle itself, the same amount of potential energy will be available as would be if the simplest forms of oxidation were reached at a bound. If lactic acid be the intermediate product of oxidation before carbonic acid, its passage into the latter must be very rapid, for that is continually eliminated from a muscle during its action. And if we thus constantly find that carbonic acid, the highest oxidised form of carbon, is manifested in the substance of muscle during its activity, it is certainly to be expected that the less oxidised form of amido-carbonic acid should be simultaneously produced. In those cases of disease where elimination of urea is retarded, it is found abundantly in the muscles. Thus, in cholera, especially in the muscles which have been severely cramped, urea is detected with ease. In this disease there is a small amount of chloride of sodium in the blood, and its solvent action on the urea is thus reduced. In uræmia, also, it can readily be extracted from muscular substance.§§ Although in the muscles of certain kinds of fish, as in the *Plageostomata* (Frierichs and Städeler), urea may be always found, yet Liebig||| searched for it in vain in the muscles of healthy mammals. Yet this is not surprising when we consider how long search was made for urea in the blood without success. Although the blood contains the sum of the urea of all the transformations proceeding throughout the body, yet as Marchand¶¶ has shown, the quantity of it which can exist in the blood at any one time is so small that it may readily escape detection. If this be true in regard to blood, it is *a fortiori* true in respect to flesh from which the blood is rapidly removing waste matter in the process of the reparation of the exhausted muscle. It may be possible that creatin\* is intermediate between tissue and urea, but this is

a pure speculation; for although we are acquainted with processes by which it can be split into sarkosin and urea, we know of no simple oxidation which will effect this change. Let us inquire how much urea we may expect to find in flesh in a given time, and it will not appear wonderful that it has escaped detection, even in the skilled hands of Liebig. In an adult man, 520 grains of urea are secreted in twenty-four hours; hence in one hour  $\frac{520}{24} = 22$  grains. Now, although we know that blood is incessantly and promptly removing waste material from the muscles, let us suppose that a quarter of an hour elapses without any of it being taken up, and that the man is killed at this period. Distributed through all the muscles of his body, there would be about 5 grains of urea; and in 10 lbs. weight of fresh flesh, the quantity operated upon by Liebig, there could not be more than 0.4 grains of urea, or 0.026 gramme. In this estimation we take the weight of fresh flesh at 1800 ounces. In our present state of analysis for urea this small quantity could not be detected.

22. In considering the origin of energy in the muscles, one of three sources is alone conceivable—(1.) The energy might arise in the circulating fluid itself; or, (2.) The oxygen of the blood might consume the fat deposited in the muscle; or (3.) The substance of the muscle must be transformed to provide the energy.†

We have already (§ 20) shown that the changes which take place in muscle during contraction occur in its substance, and not in the circulating fluid of the capillaries, for irritability continues for a considerable time after the blood has been cut off; and we might here recall the well-known fact, that in spite of a larger quantity of oxygen being taken into the lungs than of carbonic acid evolved, and consequently a necessary evolution of latent heat, the blood of the left side of the heart is 0.2 degrees cooler than that of the right side, showing that oxidation of material is not largely effected during aëration of the blood. We may therefore proceed to the second possible source of energy—the combustion of the fat in the substance of muscle.

23. The usual function of fat is unquestionably, like that of starch or of sugar, to keep up the heat of the animal. When they have served this purpose their physiological work is completed, and the *opus calorificum* cannot be changed into *opus mechanicum*, for that must be due to converted heat, or to force, which has never assumed that form. We know that all the fat and starch in food is required to account for the animal heat, because it has always been a difficulty to reconcile the experimental heat actually generated by an animal with the amount available in the food-fuel supplied to it. In fact, until the researches of Andrews, and of Favre and Silberman, gave to us higher calorific values for hydrogen and carbon than formerly, there was no possibility of accounting for the heat actually given out by animals in the experiments of Dulong.‡

† We do not consider it necessary in the present state of science to present a fourth alternative of the origin of the energy from “nervous force.” Some old experiments of Matteucci are still, however, constantly quoted in support of this view. He says (“Phys. Phen. of Living Beings,” p. 325) that the chemical action of three milligrammes of zinc, oxidating and converted into nervous force, in a frog, produced a muscular power equal to 5.419 metre kilos. But the current emanating from the zinc could only have exercised a directive action on the muscle which it affected. The total energy derivable from the zinc can be found as follows:—

$$\left( \frac{0.03 \times 1301}{1000} \right) \times 4200 = 1.64 \text{ metre kilos.}$$

Deducting this from 5.42 actually got in the experiment, 3.78 metre kilos. of work must have been obtained from some other source of energy beyond the zinc. There is no other source than the substance of the muscle itself. So long as a muscle is alive and in contact with oxygen it can contract under electrical excitement, and the difference between the work which could be done by the exciting force and the useful work obtained, must be the measure of the energy rendered available by the structural and molecular change of the muscle itself. In a later memoir (*Phil. Trans.*, 1857), Matteucci compares the exciting current to the spark which ignites gunpowder, and would seem to have abandoned his former ideas.

‡ Berl. Med. Eney. art., “Thierische Wärme;” compare also Fick, Med. Physik. S. 175, *et seq.*

\*\* *Gazette Medicale*, 1851, and Croonian Lecture, R.S., 1861; compare also Stannius, *Vierordt's Archiv.* 1852.

†† Human Physiology, p. 446.

‡‡ Lectures on Epilepsy, 129.

§§ Buhl und Voit, *Zeitsch. für rat. Med.*, vi. 94; and Von Bibra, *Ann. der Ch. und Phar.*, xciv., 206-215.

||| “Chemistry of Food,” p. 142.

¶¶ *Pogg. Ann.*, xxxi., 303.

\* *Schottin Archiv. für Heilkunde*, 1860 417.



And even with these increased co-efficients, we require the combustion of all the non-nitrogenous constituents of food to enable us to account for animal heat. But although this is the case, we must bear in mind that only a small quantity of converted heat is theoretically necessary for mechanical work. The energy available in 22 oz. of a starch equivalent of fuel, consumed by a healthy man, would correspond to 2187 kil. units of heat; while the transformation of the muscles of that man, required for mechanical force, yields about 543 kil. units. Although nearly one-half of the latter is spent in internal dynamical work, and passes into heat within the body, still we cannot afford to subtract any of the available work from the heat-givers. Taking it in round numbers, we have 2500 kil. units of heat available from them and converted vital work, and 2700 kil. units are required, according to the estimate of Helmholtz, to account for evaporation, heating of the ingesta, and radiation. The diversion, therefore, of the ordinary ingredients of food, whose proper function is *opus calorificum*, to the production of *opus mechanicum*, is not probable from *à priori* considerations. But it is nevertheless a fact that fat is always present in healthy muscle, and it is desirable to consider its relation to muscular action.

24. The experiments made by Bidder and Schmidt§ on starving cats, and by Bischof and Voit on a starving dog,|| throw light on this subject. From these we learn that during the whole course of starvation fat disappears from the muscle in a regular manner, while there is no such regularity as to the waste of the tissues. The amount of urea falls to one-half in two days; then remains constant for a week, falling again rapidly and considerably two days previous to death; during all this time the daily waste of fat remains nearly constant. Nor is there anything surprising in this difference. As the animal becomes weaker, the internal dynamical or vital motions decrease, and their representative in the urine naturally falls. But the fat continues to burn in the living lamp as steadily as the lungs afford to it oxygen.

When Bischof and Voit supplied their starving dog with fat, the waste of the body, as evidenced by the lessened amount of urea secreted, was diminished, because the fat supported the respiration, which before had partially to depend on wasting tissues. The fat cast over them a protective influence, and limited their waste to the support of their own dynamic functions. And in this fact would seem to be the use of fat after it is stored up in the muscle. We allude to its chemical use; for its mechanical advantage in lessening friction, and its possible histogenetic employment in the formation of cells, are not under consideration. Fat does not form a portion of an organ, for ether can extract it without any lesion of the organic structure. In wild animals the muscular fat is present in only small proportion—not exceeding 2 per cent. of the muscle. In the muscle of an active man the fat amounts to 2.2 per cent. A man in ordinary health and activity wastes daily 1750 grains of dry flesh, or 7000 grains of fresh muscle, which would contain 150 grains of fat. The total amount of heat which this quantity could yield by its combustion is 87 kil. units, while the flesh in which it resides would give by its transformation about 506 kil. units. We need not, therefore, look for the source of potential energy in a minor when we have a major source quite sufficient to account for it. The human heart weighs, on an average, 9.4 oz., and contains, according to Böttcher, a mean of 1.7 per cent. of fat. On the extravagant supposition, in § 18, that it destroys more than half its substance daily in movements, it would use 147.7 grammes, containing 2.5 grammes of fat. This quantity could, by its combustion, give 23.9 kil. units of heat, or 10,157 metre kil. of mechanical force. But we have shown that the useful work of the heart is 37,780 metre kils. So that the fat cannot account for the work performed. In these calculations we refer to fat dis-

tributed in and inherent to healthy muscle, and not to masses of fat in adipose tissue, such as we find in fattened animals or obese men, for no one pretends that such separate fat can be the cause of movement in any other sense than that starch, sugar, or other body extraneous to the muscle, may, by some unknown or inconceivable method, have this force transformed from *opus calorificum* to *opus mechanicum*. The chemical use of fat deposited within the muscle may be to protect it from the assaults of oxygen during its repose. A muscle, even at rest, gives out carbonic acid, which is no doubt partly due to the oxidation of its effete particles, but also to the oxidation of fat. The conception that the latter is the source of muscular action can only have arisen from the false analogy of the animal body to a steam-engine. But incessant transformation of the acting parts of the animal machine forms the condition for its action, while in the case of the steam-engine, it is transformation of fuel external to the machine which causes it to move.

25. From the considerations which have preceded, we consider Liebig amply justified in viewing the non-nitrogenous portions of food as mere heat-givers. They never can act vicariously for albuminous bodies as tissue-formers, although tissues may and do evolve heat by transformation when required to do so. That heat-givers do operate indirectly on the waste of tissues cannot be questioned. They facilitate transformation by keeping up animal heat and by the promotion of circulation. Cold-blooded reptiles become more active when artificial warmth is supplied to them, and conversely, warm-blooded mammals become more sluggish when the heat of their bodies falls, as during hibernation. Such dependencies of different groups of food, acting co-ordinately, are incessantly found, but nevertheless each group has its own specific work to perform.

26. While we have been led to the conclusion that the transformation of the tissues is the source of dynamical power in the animal, we have yet to examine whether the appearance of heat, and electro-motive force current in the muscles, may not be produced so as to absorb the force on which we have relied. The muscle during contraction is certainly hotter than at rest, about 0.5° C. warmer, according to Becquerel and Brechet. In fever, the temperature of the muscles rises sometimes to 40° or 41° C., and in tetanus to 44° C. (Ludwig); while Fick has shown that in these cases the muscles are hotter than the circulating blood. But the experiments have been made when the waste of tissue is not producing useful work, and must therefore necessarily pass into heat. Beclard¶ found, in fact, that the heat developed in a muscle is in inverse ratio to the mechanical effects produced; for example, in trying to raise insuperable weights, more heat is evolved than in lifting lighter weights.\*\* Hirn also ascertained, by direct experiment on a treadmill, that less heat is evolved for each gramme of oxygen taken into the body when hard work is done outside the body. In fact, the heat developed in muscles, when not due to the combustion of fat, is probably only the result of lost work, just as we find that the electro-motive force disappears almost entirely during the active work of a muscle or nerve†† (Du Bois Raymond). Even with the wonderful economy of force which the animal as a machine exhibits, we cannot be surprised that some of the lost work is manifested in the forms of heat and electricity. We know, for instance, that all the potential energy rendered available for internal dynamical work must assume ultimately these forms.

(To be continued.)

**Chemical Society.**—The next meeting of this Society will take place on Thursday evening next, at eight o'clock, when the President, Dr. W. A. Miller, F.R.S., will read a paper "On some Points in the Analysis of Potable Waters."

§ Das Stoffwechsel, 1852.

|| Die Gesetze der Ernährung, etc., p. 97, et seq.

¶ Comptes Rendus, 1860, i. 471.

\*\* Théorie Mécanique de la Chaleur, i. 34.

†† Untersuchungen über Thierische Electricität, bd. ii., 511.



CHEMICAL SOCIETY.

Thursday, May 18.

Prof. W. A. MILLER, M.D., F.R.S., President, in the Chair.

THE minutes of proceedings of the last meeting were read and confirmed, and Messrs. Robert Barton and Thomas N. Kirkham formally admitted Fellows of the Society. Certificates in favour of Mr. George Bacon Sweeting, Surgeon, of King's Lynn, Norfolk, and Mr. W. A. Tilden, of the Pharmaceutical Society's Laboratory, Bloomsbury Square, were read for the first and second times respectively. The ballot was taken for the election of Mr. Thomas Fairley, Medical School, Leeds; Mr. Edward Swann, Director of the Laboratory of the London and North-Western Railway Company's Works, Crewe; and Mr. Alfred Upward, Superintendent of the Chartered Gas Company's Works, 148, Goswell Street, London. These gentlemen were severally elected Fellows of the Society.

Dr. J. H. GLADSTONE delivered a discourse "*On the Specific Refractive Energies of the Elements and their Compounds*," in which he described the further results of the conjoint labours of himself and the Rev. T. P. Dale, M.A., in a branch of physical research which had been already sketched out in a paper read before the Royal Society, in March, 1863. Since the date of this communication, the subject had been taken in hand by Landolt, who adopted a mode of working very similar to that of the authors. The "specific refractive energy" of a body is a constant, not affected by temperature, and is arrived at by dividing the refractive index of the substance ( $\mu$ ) minus 1, by the density. The formula already proposed was found to hold good on a more extended investigation of the subject, and the authors generally worked with the fixed line A. The proposition resolved itself into a study of the inquiry whether the specific refractive energy of an element was invariable under all circumstances of isolation or combination, and whether this property in the case of a compound was correctly expressed by taking the mean of the refractive energies of its several elementary constituents. As a general rule this was found to be the case, but the authors brought forward a few exceptional instances which at present appeared to stand in opposition to their statement. Dr. Gladstone particularly referred to sulphurous acid, hydrated sulphuric acid, and aqueous tartaric acid, as presenting anomalies which were considered worthy of more extended investigation, with the view of determining the nature of the disturbing causes. This mode of physical research was interesting in connexion with the study of isomerism, and would probably lend valuable aid in determining the internal constitution of bodies; thus, whilst aniline and its isomer, picoline, gave widely different results under this optical treatment, it had been found by Landolt that a mixture of equal equivalents of methylic alcohol and acetic acid behaved precisely like its theoretical conjugate, glycerin! Dr. Gladstone exhibited in a tabulated form the numbers representing the specific refractive energies of many of the elements, multiplied by their atomic weights, or "refraction equivalents," as Landolt terms it, and he worked several examples by way of showing the application of the formula, and the mode of deducing from compound bodies the value of each constituent. The table stood thus:—

Name of element.	Refraction equivalent.
Carbon . . . . .	5.1
Hydrogen . . . . .	1.5
Oxygen . . . . .	3.0
Nitrogen . . . . .	3.3
Chlorine . . . . .	8.5
Bromine . . . . .	15.7
Iodine . . . . .	24.4
Sulphur . . . . .	16.0
Phosphorus . . . . .	18.6
Tin . . . . .	22.0
Sodium . . . . .	6.0
Mercury . . . . .	11.0

With regard to the value of carbon it was shown that the number observed in the case of the diamond agreed with the results deduced from the examination of carbonic oxide, carbonic acid, olefiant gas, and a variety of liquid hydrocarbons. Hydrogen did not appear to have precisely the same value in the form of gas that it had in certain hydrogen compounds, and the author stated that 7.6 was the average expression, from a great number of experiments, of the value of  $\text{CH}_2$ , the oft-quoted increment of carbon and hydrogen in the homologous series. Nitrogen in the form of gas was 3.3 as above, but in combination its value sometimes amounted to 4.2. In a similar manner the numbers representing oxygen and chlorine gases became subject to modification when those elements were combined.

The PRESIDENT said he had listened with much pleasure to the author's interesting communication, and he wished now to inquire of Dr. Gladstone whether there appeared to be any relation between the remarkable exceptions noticed by him and their observed atomic volume. It was known that oxygen in combination occupied two different atomic volumes, and he thought it possible that there might be some connexion between the volume and refractive energy in this and other similar instances.

The Rev. THOMAS PELHAM DALE gave an account of the mode by which these conclusions had been arrived at, stating that Dr. Gladstone usually undertook the experimental, and himself the mathematical, department of the inquiry. The formula adhered to in calculating the refractive values was—

$$1 \frac{\mu - 1}{d} = c,$$

and the speaker insisted upon the importance of selecting bodies of high refractive indices—such as bisulphide of carbon—for the purpose of testing the accuracy of the proposed theory. The liquid named was readily procured and purified, and its refractive index for the red rays was 1.6, and for the violet 1.7. Errors might arise from inaccuracies of adjustment, or from an elevation of temperature in the liquid contents of the prism by the passage of the solar beam; but Dr. Gladstone had employed a liquid septum—such as alum solution—in order to cut off the heat rays, and it was not possible that the figure of the hollow prism underwent any sensible alteration during the experiments, inasmuch as frequent observations made with the same liquid gave closely concordant results. He would, however, recommend the use of a prism of 60 degrees, or an equilateral triangle, and make three independent observations, changing the angle each time, and then take the mean of the three results.

Dr. FRANKLAND had hoped that the optical results would have suggested an explanation of the difference observed in the chemical properties of carbon in the form of carbonic oxide, and the more active state of that element existing in combination with hydrogen in olefiant or marsh gas. It appeared that the specific refractive energy remained constant throughout, and that optically there was no distinction between one and the other form of carbon.

Dr. GLADSTONE replied that his experiments did not indicate the well-marked chemical difference to which Dr. Frankland had alluded. The speaker offered some further remarks with reference to the details of the optical arrangement, and stated that M. Landolt and Professor Stokes had seen no theoretical difficulty in accepting the proposed formula.

The PRESIDENT then moved a vote of thanks to Dr. Gladstone and Mr. Dale for their interesting communication, which was warmly responded to, and adjourned the meeting until June 1, on which occasion he would have the honour of addressing the Society upon the subject of "*The Analysis of Potable Waters*."



## ACADEMY OF SCIENCES.

May 15, 1865.

A MEMOIR "On the Action of the Metalloids on Glass, and on the Presence of Alkaline Sulphates in all Commercial Glass," by M. Pelouze, was read. Carbon, sulphur, silicium, boron,—all would appear to give a yellow colour to glass. Hydrogen also, when passed over the glass in fusion, seems to cause a yellow colouration. How does this happen? All ordinary glass, says M. Pelouze, contains sulphates, and the colouration is due to their reduction, sulphur in every case being the efficient cause of the colour; for glass perfectly free from sulphates remains uncoloured with the before mentioned metalloids; and the same glass is coloured directly by sulphur, and alkaline or earthy sulphides.

The first part of some "Chemical Researches on Hydraulic Cements," by M. Fremy, was read. This paper is of considerable industrial importance, and we shall return to the experimental part. In the meantime we give the author's conclusions as to the cause of the setting of the cements under water. This results, he says, from two different chemical actions. In the one the aluminates of lime become hydrated, and in the other hydrated lime combines with the silicates. The aluminates and the calcareous silicates the author believes to play different parts in the setting: the former simply become hydrated, the latter combine with hydrate of lime. In a future number we shall give an abstract of the experiments described by the author.

M. de la Rive presented a note "On the Conduction of Electricity by Metallic Vapours;" these, the author shows, have the same or nearly the same conducting power as the metals in the solid state. The metals were vapourised by the voltaic arc, and on endeavouring to produce the arc with points made of various alloys the author observed that the alloy was always decomposed. To observe this phenomenon better he employed a plate of coke for a negative electrode, and the alloy for the positive, and then was able to collect the two metals which deposited separately on the coke.

In another note M. de la Rive mentioned that a piece of crown or heavy flint glass through which a discharge from a large Rhumkorff is passed, undergoes a permanent molecular modification in its whole extent, losing almost entirely its rotatory magnetic power, and acquiring the properties of a crystalline body, or glass suddenly cooled.

M. Kuhlmann communicated the fourth part of his "Researches on the Crystallogenic Force," in which he shows that crystals produced at a low temperature have forms different to those produced at the ordinary temperature, and are capable of holding much more water. This latter property is not confined to ordinary salts, but extends to sugar, oxalic acid, and other crystallisable organic matters.

M. Persoz presented a "Second Memoir on the Molecular State of Bodies," from which an extract was read. The memoir is of great theoretical interest, and we shall translate this extract shortly.

A note by M. Dietzenbacher, "On Some Properties of Nitric Acid," gave an account of some of the effects produced by a mixture of mono-hydrated nitric acid and Nordhausen sulphuric acid. Such a mixture in the cold instantly oxidises roll sulphur, sets fire to charcoal, soot, and phosphorus, ordinary or red, converts in a few minutes arsenic into arsenious acid—is, in fact, one of the most energetic of oxidising agents. On boiling such a mixture in a retort, oxygen is abundantly given off. The mixture, however, in the cold has no action on some of the most oxidisable metals.

M. Gernez made another communication "On Supersaturated Solutions," in which he again recommends the supersaturated solution of salt as a test for the most minute portions of the same salt in the air, which will, of course, provoke crystallisation in the solution—a test

which, he has said before, is more delicate than the spectrum.

Dr. Phipson sent a note "On the Existence of Silicium in Two States in Cast Iron, and on the Influence of these on the Production of Steel by Bessemer's Process." As combined and graphitic carbon exist in cast iron, so the author finds that silicium also exists in two conditions therein; and he adds that as one or the other of these predominates, so we get good or bad steel—a sample in which the uncombined predominates giving the best. Dr. Phipson promises to give in another note his method of estimating the two kinds of carbon and silicium.

M. V. de Luynes presented a note "On the Reciprocal Action of Orcine and Ammonia," in which he shows that oricine absorbs gaseous ammonia with great avidity, and that when the two bodies are brought together in the presence of ether, a crystallised compound of the two is obtained, which is colourless, but changes instantly to violet on coming in contact with the air, without passing through the different shades, which a solution of oricine in ammonia does.

M. Hardy announced in a note the discovery of a large deposit of *Guano formed by Bats*. It is in a large cavern, in which innumerable multitudes of these animals hide themselves during daylight. The composition of the guano when dry corresponds pretty closely to that of good Peruvian, but as found in the cave it contains 60 per cent. of moisture.

## NOTICES OF BOOKS.

*The Book of Perfumes.* By EUGENE RIMMEL. London: Chapman and Hall. 1865.

It is not often that a reviewer has such a volume as this under his notice. Elegantly bound and deliciously perfumed,—well written, well printed, and well illustrated,—interesting and instructive to read, pleasant to look at, and agreeable to smell, the book charms at once the intellect and the senses.

It is not, as some might imagine, a collection of recipes. Mr. Rimmel would hardly publish his best, and he is too conscientious to deceive his readers with bad. All our pharmaceutical readers know that the published recipes for perfumes are seldom good for anything, and religiously keep their own secrets if they have any. They cannot therefore, blame the author for doing the same. What Mr. Rimmel does give is an interesting account of the use of perfumes and cosmetics in all countries and in all ages. In this there is necessarily much curious information collected from varied sources,—the sacred books, the ancient satirists, and modern travellers supplying the writer with illustrations of the vanities of mankind in various times and places.

But the scientific and commercial aspects of the matter are not altogether overlooked. The reader will find a chapter on the "physiology of perfumes," and also an excellent account of the commercial uses of flowers and plants, and the materials used in perfumery.

The book is essentially a drawing-room book, and will form an agreeable present for any intelligent lady.

*Journal de Pharmacie et de Chimie*, April, 1865.

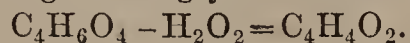
SEVERAL papers from the *Comptes Rendus* of the Academy of Sciences appear in this Journal. Most of these we may pass by, but one, by M. Berthelot, which we overlooked at the time, may be referred to here, seeing that all this gentleman writes deserves the serious attention of chemists. It describes a new sort of isomerism, or *Kenomerism*, from *κενον*, empty. The word may not be well chosen, but the following describes the application of it. Two distinct compounds may by certain reactions lose different groups of elements, and so be reduced to an identical composition,



while they possess different physical and chemical characters, and yet retain something of the structure of the original compounds. Alcohol, for instance, may lose two equivalents of hydrogen and become converted into aldehyd—



Glycol, on the other hand, may lose two equivalents of water and be changed into glycolic ether—



Glycolic ether and aldehyde are isomers; their composition is the same, but their physical and chemical properties are very different. Here is a perfect case of kenomerism. The author quotes other cases, to which we may return.

We find here for the first time a note by M. Chatin "*On the Milk of the Dromedary*." This milk is described as perfectly white, of an agreeable taste, and without odour. The fat globules are much smaller than those of cow's milk; the density of the milk rises to 1.042 from its richness in sugar; casein and albumen also are more abundant than in the milk of the cow, amounting to  $\frac{40}{1000}$ . The milk, therefore, appears to be very nutritious, and from the extremely divided state of the fatty matter, very digestible.

A paper by M. F. Ceresoli, "*On Valerianic Acid and the Valerianates of Quinine and Zinc*," gives an account of these bodies which may interest our pharmaceutical readers, and which we shall therefore translate.

A note by M. Commaille, "*On Valerianate of Quinine mixed with Atropine*," relates the detection of the latter body in some of the valerianate. How these two bodies came together we can only conjecture, and such a mixture is hardly likely to be made again, but we shall give the author's method of detecting atropine under such circumstances.

A paper by M. Pons, "*On a Volumetric Method of Estimating the Value of Soaps*," is Clark's test reversed. The author uses a standard solution of chloride of calcium to determine the richness of soaps in fatty acids, adopting mottled Marseilles or Castile soap, as containing the smallest amount of water and no solid adulterants, for a standard soap. The idea is perhaps a good one, and we shall give M. Pons' process.

An extract from the *Proceedings* of the Pharmaceutical Society of Paris contains some observations by M. Roussin "*On the Solidification of Balsam of Copaiba by Lime and Magnesia*." The author shows that the presence of water is necessary for the solidification to take place, and that calcined magnesia has a strong affinity for moisture, sometimes taking from the atmosphere as much as 15 or 20 per cent. of its weight.

A few short notices we transfer to our "Miscellaneous" paragraphs.

*Journal für Praktische Chemie.* No. 4, 1865.

THE first paper is Dr. Laspeyre's "*On a Simple and Accurate Process for Estimating Alkalies*." The process applies to the analysis of rocks, and however accurate it may be, it appears anything but simple. We have also the continuation of Dr. Heldt's "*Studies on Cements*," and papers by Rammelsberg, which we have already noticed. Crystallographers may, perhaps, read with interest a paper by Carl Ritter von Hauer "*On Cubical and Hemihedral Alum Crystals*." A note "*On the Separation of Manganese*," by Dr. Rube, gives a process which we condense. In the analyses of rocks, after the separation of silica by evaporation of the hydrochloric solution, the part soluble in hydrochloric acid will contain the manganese, iron, alumina, &c. This solution the author concentrates, neutralises with carbonate of soda if much free acid is present, and then heats to boiling in a porcelain dish. While boiling he adds freshly precipitated mercuric oxide suspended in water, and continues the boiling for an hour and a half. In this time the suboxide is oxidised to per-

oxide of manganese, which goes down with peroxide of iron and alumina, lime and magnesia remaining in solution. The author directs the addition of the mercuric oxide until its colour is distinctly recognisable in the precipitate. The manganese, iron, and alumina in the precipitate have then to be separated from mercury and from each other. We do not see any particular advantages in this process.

*Chemisches Central Blatt.* Nos. 18 and 19, 1865.

ALL the papers in No. 18 have received some notice in the CHEMICAL NEWS. No. 19 contains a short notice by Dr. Vohl, "*On a Compound of Chloride of Zinc with Aniline, and its Use in the Preparation of Aniline Dyes*," which we transfer to our pages in another place. There is also an extended notice of Vogel's "*Volumetric Method of Estimating Silver*," an outline of which we have already given, but now extract the details. A note "*On the Preparation of Gold Purple*" we transfer to our miscellaneous paragraphs. All the other papers have been noticed.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1227. F. Wise, Chandos Chambers, Adelphi, "A mode of obtaining decoctions and apparatus for carrying the same into effect." A communication from B. G. Martin, Philadelphia, Penn., U.S.A.—Petition recorded May 2, 1865.

1255. W. Henderson, Glasgow, "Improvements in extracting copper and several other metals from certain ores of these metals."

1257. J. Mayall, Roxbury, Mass., U.S.A., "Improvements in the manufacture or treatment of indiarubber or gutta-percha or compounds thereof, applicable to the production of stereotype plates and other forms."—May 5, 1865.

1279. J. G. Hey, Cleckheaton, Yorkshire, V. Savory, Harlishead-cum-Clifton, Yorkshire, "An improved self-acting apparatus for and means of extinguishing fires."

### NOTICES TO PROCEED.

15. L. D'Aubréville, Boulevard de Strasbourg, Paris, "Improvements in manufacturing paper."—A communication from J. J. Manecy, Fures, France.—Petition recorded January 3, 1865.

39. T. Pickford, Fenchurch Street, "Improvements in preparing and keeping aerated beverages."—Jan. 5, 1865.

42. J. Lebandy, Paris, "A new system of boiling grain sugar in vacuo."

47. W. C. Thurgar, Norwich, "A new or improved method of keeping the substance of eggs fresh and sweet."—Jan. 6, 1865.

56. B. W. Bentley, Buxton, Derbyshire, and W. H. Bailey, Salford, Lancashire, "Improvements in producing and finishing photographs and photographic transparencies on paper and other suitable substances, and in the machinery employed therein."—Jan. 7, 1865.

72. E. Pettitt, Birmingham, "Improvements in giving permanence to, and in ornamenting glass transparent positive photographs."—Jan. 10, 1865.

110. W. S. Longridge, Alderwasely Iron Works, Derbyshire, and J. Mash, Bowden, Cheshire, "Improvements in furnaces."—Jan. 13, 1865.

320. W. E. Newton, Chancery Lane, "Improvements in the preparation of superphosphate of lime."—A communication from R. B. Potts, Camden, N.J., U.S.A.—Feb. 4, 1865.

836.—W. E. Newton, Chancery Lane, "Improvements in the manufacture of ink."—A communication from J. V. Lavers, Sydney, New South Wales, March 24, 1865.



## CORRESPONDENCE.

*Continental Science.*

PARIS, May 19.

THE annual meeting of the Society of Friends of Science was held at the Sorbonne on the 4th inst. After an opening address by Marshal Vaillant, and a speech by M. Boudet in support of a scientific relief fund started years ago by Thénard, but not much subscribed to, M. Troost delivered a lecture "*On Magnesium and its Applications.*" After describing the manufacture of the metal, he proceeded of course to show the light of magnesium itself, and then of the zinc and magnesium twist devised by M. Leroux. These two metals burn together freely; the light seems to equal that of magnesium by itself, and is of course much more economical. I think I remember having seen in the CHEMICAL NEWS an estimation of the amount of light produced by the combustion of a magnesium wire; but I may as well quote the figures of M. Troost, who is always accurate. He said that a wire 97 millimetres long and one-third of a millimetre thick, gives the light of 64 candles. The French candle standard differs but little from yours, and indeed for ordinary purposes may be taken as the same. M. Troost showed an unpublished experiment of MM. Deville and Caron, who have discovered that magnesium instantly decomposes the vapour of water. If a current of steam is passed into a tube containing fragments of the metal the hydrogen may be burnt at the opposite extremity.

Speaking of M. H. Deville, I may mention here an experiment which that gentleman showed at the last meeting of the Academy. He ignited a stick of charcoal by dipping it into a mixture of monohydrated nitric acid and fuming sulphuric acid. The ignition took place instantaneously.

I read in *Cosmos* that a gold mine of extraordinary richness has been discovered near Grisslehamm, in Sweden. The annual produce is estimated at 20,000 kilogrammes, the value of which at the Bank of England price I must leave your readers to calculate for themselves.

The exhibition of the French Photographic Society is open; but there appears to be nothing worthy of special notice. Photography would seem susceptible of no further development.

The nomadic tribes who inhabit the Steppes of Russia are said to be completely exempt from pulmonary consumption. Another special peculiarity in these people is that they indulge in *Kumis*—an intoxicating liquid made by fermenting mare's milk. Here are two facts for a medical logician, and the inference to be drawn from them is clear. *Kumis* is prophylactic against consumption—so, at all events, says Dr. Schnepf. But mare's milk is not easy to get here, and the Doctor is obliged to content himself with the nearest approach to that fluid he can find—namely, asses' milk,—from which he prepares an intoxicating drink called *galazyme*, with which he says he treats most successfully all catarrhal affections and consumptions in general.

## MISCELLANEOUS.

**Royal Society.**—The following are the candidates selected by the Council for admission this year:—Henry Christy, Esq.; the Hon. James Cockle, M.A.; Rev. William Rutter Dawes; Archibald Geikie, Esq.; George Gore, Esq.; Robert Grant, Esq., M.A.; George Harley, M.D.; William Huggins, Esq.; Sir F. Leopold McClintock, Capt. R.N.; Robert McDonnell, M.D.; William Kitchen Parker, Esq.; Alfred Tennyson, Esq., D.C.L.; George Henry Kendrick Thwaites, Esq.; Lieut.-Col. James Thomas Walker, R.E.; George Robert Gray, Esq. [We do not observe the name of one chemist on the list.]

**Royal Institution.**—The following are the arrangements for the ensuing week:—Tuesday, May 30, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Thursday, June 1, at 4 o'clock, Professor Frankland, F.R.S., "On Organic Chemistry." Friday, June 2, at 8 o'clock, Professor Huxley, F.R.S., "On the Methods and Results of Ethnology." Saturday, June 3, at 4 o'clock, Alexander Herschel, Esq., "On Meteorology."

**Metalliferous Mines Bill.**—Lord Kinnaird has withdrawn the Metalliferous Mines Bill, and for the present no legislation on the subject can be expected. We hope, however, that the noble Lord will persevere in his attempts to secure for the metal miner equal protection with the coal miner.

**Working of the Alkali Act.**—The first Report of Dr. A. Smith, the Chief Inspector under the Alkali Act, has just been presented to Parliament, and was on Tuesday last the subject of a speech by Lord Derby. The noble Lord congratulated himself on the perfect success of the measure of which he was the author, and paid a merited compliment to Dr. Smith, whose conciliatory proceedings secured the hearty co-operation of the manufacturers. We shall notice the report at length shortly, and now shall only state that every one of the sixty-four works reported upon condense more hydrochloric acid than the Act compels; thirty-three works allow none, or not more than 0.1 per cent. to escape.

**Telegraphic Cables.**—Any fact that contributes to the stock of our experience relative to the adaptability of certain materials for the construction of telegraph cables for submarine and subterranean purposes should be deemed valuable, and ought not to be devoid of general interest. A portion of one of the cables made by Messrs. Wells and Hall for the Ordnance Select Committee, laid down at Shoeburyness, has been uncovered during the past few days, and a length cut out to ascertain its condition. After having been buried in the marshes for nearly four years, these wires are found to be electrically perfect. The india-rubber is in high preservation, showing not the slightest sign of decay, but retaining the hard, clear, semi-transparent appearance of Para rubber in its natural state. One well-ascertained fact is worth any number of theories; and having been favoured with a sample of the cable, we are speaking from ocular proof. It is most satisfactory, too, as indicating at least the possibility of making india-rubber wires proof against inherent deterioration. The felt, by which the exterior of the rubber is covered, is also intact; this is doubtless owing to its being a substance, to a certain extent, composed of india-rubber, that material, when in a state of solution, forming a sort of ground upon which the cotton fibre is spread. A serving of tarred yarn, to afford strength and protection to the core, forms the outer part of the cables; but it appears this only lasts for a time. The hemp has completely rotted off, and these wires have had no other protection but the rubber probably for the latter half of the period they have been down, and the perfect state of the rubber would seem to indicate that they did not require any other protection. At any rate, this effectually explodes the notion that tar is a preservative of hemp, when laid underground or in water. It probably might be made more durable if saturated with a compound consisting mainly of the material which forms the core.

## ANSWERS TO CORRESPONDENTS.

*Atom.*—The first volume of Miller's Chemistry.

*B.*—Yes, the vapour of bisulphide of carbon is very poisonous.

*J. T.*—The Patent Office has not published a general collection of chemical patents similar to the collections named. Such a publication is very desirable, and, if well classified, would be extremely useful.

*T. H.*—A glass-blower will make you the apparatus. Apply to Mr. Cetti.

In reply to several correspondents, we may state that no more of the Exhibition Reports are at present procurable. We hope to receive a further supply.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Contributions to the History of the Metals in Cerite and Gadolinite, by M. MARC DELAFONTAINE.\*

(Continued from page 242.)

**III. Note on the Spectra of Absorption of Didymium, Erbium, and Terbium.**—The spectrum of absorption of didymium, first described by M. Gladstone, is well known to all chemists; this is not the case with those of erbium and terbium. M. Bahr, who discovered them, has made them known to the Academie des Sciences of Stockholm.

I thought it would be more convenient to unite the detailed descriptions of these three spectra, a knowledge of them being so essential to distinguishing erbia, terbia, and oxide of didymium.

A very diluted solution of nitrate of didymium examined through the thickness of 7 or 8 centimetres, showed three rather indistinct black rays, indicated in Fig. 3 by *a*, *b*, *c*. The fact of this spectrum being confounded with that of terbium, may again render doubtful the existence of the latter metal, but terbic nitrate, even when fused to the state of limpid glass, shows no new ray; the others are only enlarged, and much blacker. It is not so with didymium; when part of the water has been expelled by evaporation, the three rays above mentioned change very dark bands; at the same time four others arise, denoted by the letters *d*, *e*, *f*, *g*. The whole constitutes the usual spectrum of didymium; however, with very concentrated liquids there are besides the lines *h* *i*, and one or two others difficult to distinguish in the violet. Erbium generally gives five rays and bands, and eight when it is in the form of a syrupy solution. Er persists even after the disappearance of all the others. (Fig. 1.)

As I have said, terbium is characterised by three bands, only two of which are very clear, the third, *Tr*<sub>c</sub> is indistinct and possibly does not belong to it at all. (Fig 2.)

By determining the positions by means of a graduated scale such as Na=27, Li=10, and Tl 43, I found that:

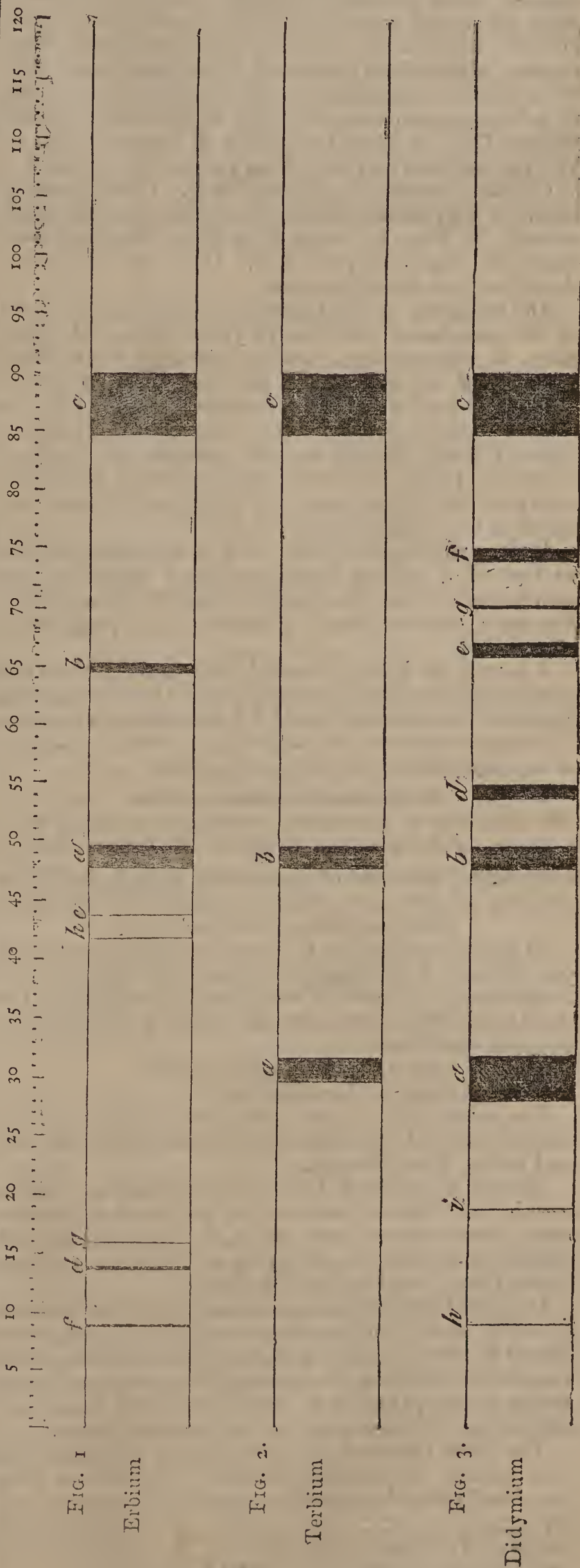
Di h = 9	Tr a = 30—32	Er f = 9
i 19	b 48—50	d 14
a 28—32	c 85—89	g 16
b 48—50		h 42
d 54—55		e 44
e 66—67		a 48—50
g 70		b 65
f 73—75		c 85—90
c 85—91		

Beyond which the positions are uncertain, except, perhaps, K=107—110.

As will be seen, two bands are common to the three elements (Di<sub>b</sub> Tr<sub>b</sub> Er<sub>a</sub> and Di<sub>e</sub> Tr<sub>c</sub> Er<sub>c</sub>) and Er<sub>f</sub> is compounded with Di<sub>h</sub>.

## Note on the Carbides of Yttrio-Ceric Metals, by M. DELAFONTAINE.

By decomposing formiate or oxalate of cerium by heat in a full and covered crucible, or better, in a tube traversed by a current of pure dry hydrogen, a greyish-black powder is produced, which will ignite and burn on contact with the air, like German tinder, if thrown while still hot on a sheet of paper or any other bad conductor of heat. This powder remains unaltered after cooling,



\* *Bibliothèque Universelle et Revue Suisse*, xxii., 30, 65.



and may then be preserved in an uncovered vessel. Digested with diluted hydrochloric acid, it slowly disengages small odourless bubbles. After two or three days the liquid contains a certain quantity of cerous chloride, while there remains an abundant dense black residuum, with difficulty attacked by mineral acids even when hot and concentrated. This product is a carbide of definite proportions, which may be represented by the formula  $CeC_2$ , in spite of an excess of carbon, which in two preparations may vary from two to four centimes.

Carbide of cerium is not a new body. Göbel formerly obtained it by means of formiate; Mosander, and quite recently M. Popp, by means of oxalate. Mosander even made an exact analysis of it. Göbel and M. Popp described it as metallic cerium.

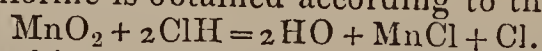
The formiates of lanthanum and didymium, oxalates of the same bases, and those of yttria, erbia, and terbia form, in decomposing, carbides bearing great analogy to those of cerium. Acids, however, seem to attack them more readily. I have frequently had occasion to observe their production in the course of my researches when I have calcined several grammes at a time of oxalate of yttria, erbia, and terbia in a small deep platinum crucible. Their presence is inconvenient in an earth which is to be redissolved.

In decomposing, formiates have a movement similar to that of a boiling liquid, and they escape by the smallest interstices, burning like fuses.\* This renders the use of oxalates much preferable in the preparation of carbides.

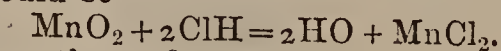
I intend to devote a special work to the various circumstances attending the curious method for decomposing formiates and oxalates to which I have drawn attention. My experiments are not sufficiently advanced to admit of my representing them by an equation.

#### *The Existence of Bichloride of Manganese and its Congeners of Bromine and Iodine, by M. J. NICKLES.†*

On treating peroxide of manganese with hydrochloric acid free chlorine is obtained according to the equation:



In giving this equation it is usually added that only half the chlorine is disengaged, because the compound corresponding to peroxide of manganese—that is to say, the perchloride  $MnCl_2$  does not exist, for if it did exist, the equation would be—



and consequently no free chlorine.

The object of this paper is to show that this perchloride may really be obtained, as also its congeners bromide and iodide, if not fluoride.

Having ascertained that, if water readily destroys certain perchlorides, perbromides, &c., ether, on the contrary, renders them more stable, I saw in this fact the possibility of filling, in the group of chlorides, a hiatus which theory has hardly tried to fill.

This may be effected in two ways, either by treating with a current of dry chlorine, the protochloride of manganese placed in ether, in alcohol, or any other anhydrous liquid capable of dissolving the compound to be obtained, or by acting on the peroxide of manganese with dry hydrochloric gas, in the presence of one of these liquids.

The latter process is the most simple and gives the best results. By merely shaking in a tube a little powdered peroxide of manganese with anhydrous ether,

saturated with hydrochloric acid gas, a liquid of a beautiful green colour, containing the compound in question, is immediately obtained.

This is a lecture experiment. It is always successful, especially when the vessel is previously cooled, for which purpose cold water will suffice, but ice is preferable. But to obtain a quantity of this perchloride, dry hydrochloric gas should be passed into a properly cooled mixture of peroxide and ether.

The product, of a green colour, alters very easily, and evolves hydrochloric acid gas. Soluble in any proportion in ether, it is insoluble in sulphide of carbon. Phosphorus decolorises it, forming protochloride of manganese, so also do iron and zinc filings, powdered antimony and sulphide of antimony; the last causes besides, a disengagement of sulphuretted hydrogen; sulphide of lead gives free sulphur, alkaline iodides give up iodine, and organic colouring matters, such as indigo, are rapidly destroyed. Water decomposes it, but its action is more prompt in the presence of hydrochloric acid.

The composition of the green solution agrees with the formula—



Though this compound is soluble in anhydrous ether, two distinct layers are not formed, as with halo-metallic ethers (*Comptes Rendus*, lv., 537); I do not, however, consider it as less well defined. In fact, this cannot be a simple solution in ether; for by treating peroxide of manganese by water saturated with hydrochloric acid, a brown liquid is obtained, becoming green in the presence of anhydrous ether, and thus forming a product similar to the preceding.

Perbromide of manganese is obtained in the same way as the perchloride, it is less stable, however, and is easily reduced into sesquibromide  $Mn_2Br_3$ .

Some remarkable analogies are connected with peroxide of manganese. The colour of all these compounds is more or less green.

This is also the colour of the compounds given by the sesquioxide  $Mn_2O_3$  with hydrochloric, hydrobromic, and hydriodic gases, ether, and anhydrous alcohol. The ethereal combinations seemed to me more stable than those obtained with alcohols. The oxide employed is the compound  $Mn_3O_4$  obtained by calcining carbonate of manganese free from iron.

These facts show the existence of a great many haloid compounds, which have not hitherto been obtained; and of this number the combinations corresponding to the oxides  $Ni_2O_3$  and  $Co_2O_3$ . I am also certain that it is possible to prepare sesqui-iodide of iron  $Fe_2I_3$ , the existence of which was left in doubt. (Gmelin, *Traité* iii., 235.) This iodide, it is true, is very unstable. Finally, I have succeeded in carrying out an idea of H. Rose's (*Poggendorf Annalen*, cv., 572, 58,) by preparing chloro-arsenic acid  $AsCl_5$ , by means of ether and dry hydrochloric gas, for which all other modes of preparation have hitherto failed.‡

Few of the higher oxides resist chloridation or bromidation by the means above described. As these oxides are then transformed into the corresponding chloride or bromide, it will be seen that this is a general process, which, properly employed, will lead to this fact—that each degree of oxidation of a metal has its representative in the group of chlorides. I hope to prove this by experiment.

\* Chemical treatises generally cite formiate of lead as the least soluble of all; however, formiate of cerium, and especially those of lanthanum and didymium, go far beyond it in this respect.

† *Comptes Rendus*, lx., 479, 65.

‡ This new acid is in the form of an ethereal combination, is unstable, and easily reduced into chloro arsenious acid. Less dense than the latter, and not miscible with it, chloro-arsenic ether separates spontaneously, and may be collected by simple decantation. With water it instantaneously gives arsenic acid.



*Presence of the Benzol Series in Canadian Petroleum,*  
by C. SCHOLEMMER, Esq.\*

PELOUZE AND CAHOURS state that American petroleum which they used did not contain hydrocarbons of the benzol series, whilst I found a not inconsiderable quantity of these compounds in the rectified petroleum from which I isolated the hydrides of heptyl, &c. As it was not impossible that this was an accidental or intentional admixture, I endeavoured to procure some genuine crude American petroleum, but I did not succeed in obtaining crude genuine Pennsylvanian, as none of it had reached the Liverpool markets for months. I, however, got some real Canadian rock oil as a thick black liquid of a very unpleasant odour. I distilled it, and treated the portion boiling below  $150^{\circ}$  C. with concentrated nitric acid, which acted violently. The acid liquid was then diluted with water, and heavy liquid nitro-compounds separated, possessing the odour of bitter almonds. These were treated with tin and hydrochloric acid, and the solution thus obtained was distilled with caustic potash. The aqueous distillate, in which some drops of an oily liquid were suspended, had the odour of aniline, and gave, with a solution of bleaching powder, the most distinct aniline reaction. The beautiful rosaniline reaction could also easily be obtained by heating one of the oily drops with bichloride of mercury. Canadian petroleum contains, therefore, the series of benzol hydrocarbons. In the preparation of hydride of decetyl from rectified petroleum, the portion boiling between  $150^{\circ}$  and  $170^{\circ}$  was purified by nitric and sulphuric acids, and thus liquid and nitro-solid compounds obtained. The solid portion was several times recrystallised from alcohol, and the whole of the needle-shaped crystals thus obtained gave on analysis numbers very nearly agreeing with the formula of trinitro cumol,  $C_9H_9(NO_2)_3$ .

*On a Convenient Process for Preparing Oxygen,*  
by M. FLEITMANN.†

THE easy preparation of oxygen for technical purposes is a matter of considerable importance, and I now shortly describe a process which possesses particular scientific interest. I was led to the process by observing that on heating a concentrated solution of chloride of lime with only a trace of freshly prepared moist peroxide of cobalt,‡ the hypochlorite of lime was completely decomposed into chloride of calcium and oxygen. Repeated quantitative experiments, the results of which I have lost, convinced me that the whole of the oxygen was evolved, and that only chloride of calcium and no chloric acid was formed.

The evolution of oxygen commences about  $70^{\circ}$  or  $80^{\circ}$ , and continues in a regular stream, with a slight frothing of the liquid.

The action of the peroxide of cobalt in this case, it is clear, is exactly like that of nitric oxide in the manufacture of sulphuric acid. There is no doubt that several peroxides of cobalt with various proportions of oxygen exist. My own experiments have shown me that the proportion of oxygen in peroxide of cobalt is variable, and the simplest explanation of this process is that a lower peroxide abstracts oxygen from the hypochlorite of lime to form a higher oxide, which is again decomposed into a lower oxide and oxygen.

The peroxide made use of in one experiment may be employed again to decompose a fresh quantity of hypo-

chlorite of lime. From one-tenth to one-half per cent. is sufficient to effect the reaction; and instead of taking the freshly prepared hydrated peroxide, it will suffice to add to the solution of hypochlorite a few drops of a solution of cobalt salt, whereby a corresponding amount of the peroxide is formed.

The advantages of this method of procuring oxygen appear to be the following:—

1. The evolution proceeds with extraordinary regularity, and the gas is collected with the greatest ease, which makes the process specially applicable as a lecture experiment. When the mixture has been heated to  $70^{\circ}$  or  $80^{\circ}$  the lamp may in general be removed, as the heat of the fluid is then sufficient to carry on the reaction to the end.

2. The whole of the oxygen is obtained from the material, while only a part is procured by heating peroxide of manganese, and

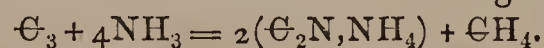
3. The process has the advantage of greater cheapness than that with chlorate of potash (either with or without manganese).

It is necessary to employ a clear solution of chloride of lime, as a thick or murky solution will froth over. The best way of making a clear and strong solution is by first extracting one portion of chloride of lime with water, decanting the clear liquor, and then make use of that to exhaust another portion of the chloride. In this way it is easy to get a liquor which will evolve from twenty-five to thirty times its volume of oxygen. On the small scale it is best to employ a capacious flask, which may be about seven eighths filled with the solution. On a large scale for technical purposes a sort of steam boiler might be used, and the oxygen so obtained under pressure, and capable of being employed as a blast.

In a note the author suggests that a very pretty experiment may be made to show the displacement of oxygen by chlorine, by passing the latter gas into a mixture of solution of caustic soda with some peroxide of cobalt. The chlorine could be passed in on one side, and oxygen collected at the other.

*The Formation of Cyanogen and the Action of Ammonia on Carbon at a Red Heat,*§ by M. WELTZIEN.

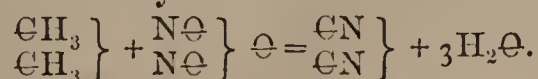
ACCORDING to M. Kuhlmann, ammonia acts on carbon giving cyanide of ammonium and marsh gas.



The author believes that this reaction does not correctly express what happens, because an uneven number of molecules of carbon take part in the reaction, and he supposes that ethylene and acetylene are formed at the same time, while, according to M. Langlois, hydrogen is set at liberty.

M. Weltzien passed dry ammoniacal gas on carbon heated to redness and previously purified by a current of chloride; cyanide of ammonium, hydrogen, and nitrogen were formed, but no carbonated hydrogen. It is to be observed that only 3 atoms out of 26 of nitrogen were used to form cyanide of ammonium.

Nitrogen being triatomic—that is to say, capable of replacing three atoms of hydrogen, the author believed it would be possible to transform methyle into cyanogen by the action of anhydrous nitrous acid.



For this purpose he passed the vapours of anhydrous

\* Note in paper on Hydrocarbons. *Trans. Roy. Soc.*, (v), xiv., p. 168.

† *Annalen der Chemie und Pharmacie*, April, 1865, p. 64.

‡ Peroxide of nickel acts in a similar way, but not so energetically.

§ *Annalen der Chemie und Pharmacie*, cxxii., 224.



nitrous acid and methyle, the latter produced by electrolysis, and consequently mixed with hydrogen, over oxide of chromium heated to redness, but he observed no formation of cyanogen.

### TECHNICAL CHEMISTRY.

*On the Compounds of Chloride of Zinc with Aniline, and their Use in the Manufacture of Dyes, by Dr. VOHL.\**

A NEUTRAL aqueous solution of chloride of zinc mixed with aniline solidifies in a short time to a crystalline mass or magma, from which the mother liquor can be easily drained. The crystals may afterwards be dissolved in boiling alcohol, from which solution the compound deposits in the form of brilliant white needles.

The author regards this salt as a *chlorozincate of aniline* ( $\text{ZnCl} + \text{C}_{12}\text{H}_7\text{N}$ ). It easily dissolves in dilute hydrochloric acid, forming a new salt—hydrochlorate of chlorozincate of aniline. On the evaporation of the solution this salt crystallises out in large colourless plates, which soon change in the air, and take a violet-blue colour. The salt is very soluble in spirit of wine and in water; strong hydrochloric acid precipitates it from the aqueous solution. It loses its water of crystallisation at  $100^\circ$ .

The first of these two compounds may be prepared directly from nitro-benzol by mixing in a retort 12.3 parts of nitro-benzol, 20 parts of zinc, 75 parts hydrochloric acid (sp. gr. 1.17), and as much alcohol as is necessary for the solution. The retort must be arranged so that the vapours given off on heating may run back into the vessel. After the formation of the aniline the mixture is kept on a water-bath at  $100^\circ$  until all the zinc is dissolved. Then a mixture of 14.5 parts of crystallised carbonate of soda, with 4 parts of dilute spirit (19 per cent.), is added; the whole heated to boiling, and the liquor filtered. On cooling, the chlorozincate of aniline crystallises out, and the crystals may be collected and pressed from the mother liquor. From 12.3 parts aniline the author obtained 15.2 of the compound, instead of 16.

For the direct preparation of the second compound, an excess of hydrochloric acid must be added at the end of the operation just described, the alcohol distilled off, and the residue evaporated to dryness on a water-bath. The compound may be purified by recrystallisation from spirit of wine or water.

To prepare fuchsine, the acid chlorozincate of aniline is mixed with the oxidising agent and heated on an oil or paraffine bath to  $180^\circ$ ; convenient proportions are 16 parts of the zinc aniline compound and from 7.2 to 8 parts of mercuric nitrate; or, still better, half mercuric and half mercurous nitrate. The mixture soon becomes dark red—almost black, indeed—and pasty; and on cooling forms a hard mass, which can be easily powdered. The purple and the red can now be separated by the usual means. Arsenic acid, chloride of tin, &c., &c., may, of course, be used as oxidisers in place of the mercuric nitrate.

Aniline blue is obtained by heating 20 parts of the acid zinc compound with 8 parts of mercurous nitrate. The mixture is slowly heated in a paraffine bath up to  $200^\circ$ . When cold, the powdered mass is extracted with boiling water, whereby the blue is separated from traces of fuchsine.

### PHYSICAL SCIENCE.

*On the Application of Spectrum Analysis to Microscopical Investigations, and especially to the Detection of Blood Stains,† by H. C. SORBY, F.R.S., &c.*

(Continued from page 234.)

It thus appears that in various conditions blood yields no less than eight very different spectra. At all events, we can most readily get four or five, so characteristic, that with proper care there could be no fear of confounding it with any other substance that I have hitherto examined, and probably not with any in existence. However, in all important investigations, it would be advisable to examine the spectra of any substance likely to be present. I would also specially insist on the importance of carefully attending to the exact position and character of the absorption-bands; and before any one gave evidence on such a subject, that he should make himself practically familiar with the facts I have described.

In applying this method to the detection of blood-stains on various articles of clothing, it is requisite to ascertain the effect of the different materials, dyes, and mordants. I have for this purpose made a great many experiments, and yet probably much remains to be learned. As a general rule, the dyes exercise little or no prejudicial influence; but when alum has been used as a mordant, it produces an effect which might easily mislead. Hitherto I have not been able to overcome the effect of the tannin in different sorts of leather. They precipitate the colouring-matter of the blood, and no spectra can be obtained. If, indeed, the blood can be scraped off from the surface without any considerable amount of leather, it can be detected as usual; but if it had been sponged or washed, probably no trace whatever could be detected. The same applies in the case of those woods which, like oak, contain tannic acid. Vegetable soil, when its amount is large in proportion to that of the blood, also precipitates the colouring matter in an insoluble form; but, where the relative amount is small, as on dirty clothes, it does not sensibly interfere with the test, though it tends to impair its delicacy.

When scarlet or brown cruorine is acted on by a solution of alum, it is converted into hæmatin. If it has been used as a mordant, sometimes a portion remains in such a condition as to produce this change in blood-stains; and, moreover, the alumina may combine with the colouring-matter of the blood, and make it insoluble. In such cases it is impossible to obtain the spectrum of either scarlet or brown cruorine; but if a piece of cloth, mordanted in this manner, marked with blood, be digested in a few drops of water in a watch-glass, and repeatedly squeezed with forceps, a turbid solution is obtained, which, treated with citric acid, filtered, rendered alkaline with ammonia, and deoxidised with protosulphate of iron, shows quite well the spectrum of deoxidised hæmatin No. 8.

In a few cases the colouring matter of the dye is slightly dissolved by water. I have especially noticed this in the case of black printed calico; and if much of such material containing very little blood be digested in water, the dye may cut off the characteristic part of the spectrum. Care should, therefore, be taken not to use any of the material not well marked with blood, and to have the solution so dilute that the dye may not cut off the green rays.

Almost everyone must have noticed the fact, that when a blood-stain on white linen or calico has been ex-

\* Dingler's Polytech. Journal, Feb., 1865, p. 211.

† From the Quarterly Journal of Science.



posed to pure air for only a short time it can be almost entirely dissolved out by water; but if dried and exposed for some time, the imperfectly soluble brown cruorine cannot be entirely removed, and leaves a brown stain, which, though readily seen on white material, might be scarcely visible on coloured or black. However, on digesting the suspected portion in a few drops of water with citric acid in a watch-glass, and proceeding as already described, a most unmistakable spectrum like No. 8 may be obtained, even when the stain is only half-an-inch square and scarcely visible. In attempting to remove a blood-stain from cloth by sponging, on the first application of the water a solution of blood would be formed, and run into the surrounding cloth by capillary attraction. Hence, though the stain may appear to have been removed, the cloth round about might, and probably would, retain abundance of the colouring matter, which could be dissolved out. Any suspicious marks that might be due to such treatment should therefore be examined with care. Of course, in such cases the microscope alone would be of no avail, and mere chemical tests could not be relied on, and thus the spectrum method becomes especially useful. Specimens of this character having been placed in the hands of some of the first authorities in such inquiries, they said that neither they nor any one else could make out anything from them; nor would they believe that I could, though the amount of blood was such that in a few minutes I could have shown such a spectrum as No. 8, and have been in a position to give evidence with great confidence.

When soap is present it causes a precipitate; but this is quite soluble in plenty of ammonia, and does not prevent our seeing the spectrum No. 8. Boiling water, instead of facilitating the removal of blood, makes it more fixed by coagulating the albumen. If the blood be dried on glass, the colour is changed to a brownish red, and it gives a spectrum like No. 5, whether dry or damp. When dissolved by citric acid it yields hæmatin, and readily gives spectrum No. 8.

In some cases foreign matters, or the mordants, make the solution so turbid that it is difficult to see the spectrum to advantage. If we wish to observe the spectrum of blood in its natural state, or as it becomes by mere exposure to the atmosphere, it is better not to filter, but to allow the solution to stand in the cell in front of the slit until it has become sufficiently clear, because filtering would probably remove much of the colouring matter of the blood. However, in some varieties of brown cloth the mordants give rise to such a turbid solution that it is very difficult to see the spectrum in a satisfactory manner. Citric acid should therefore be added to make the colouring matter more completely soluble, and the liquid filtered. For such small quantities a blotting paper filter  $\frac{3}{4}$  of an inch in diameter should be used. It can be conveniently supported on a platinum wire bent at one end into a ring, and made to slide up and down a small wire for a support; and if the bottom of the filter touch the cell or watch-glass, though the liquid may pass through slowly, the final result is far more satisfactory. After the acid solution has passed, it is well to add the ammonia by allowing it also to go through the filter, to carry away any colouring matter, soluble in that reagent, that might remain on the filter.

Though in actual practice many other facts may turn up to render special modifications necessary, yet the following is the method I should adopt in examining a mark or stain supposed to be due to blood, assuming that only a small quantity was at my disposal. I should first cut off a portion of the material where not marked, and

digest it in four or five drops of water in a watch glass, squeezing it with forceps, and moistening it over and over again. If the solution became coloured, I should introduce it into a cell and determine the character of the spectrum, both in its natural state and after having been acted on by the different reagents already mentioned. I should then add a very little blood to a few drops of water, and digest in that solution a small piece of the material, so as to make out whether it contained anything that acts on the colouring matter of blood. Having satisfied myself on these points, I should cut off a small bit of the stained portion, using from  $\frac{1}{10}$ th to  $\frac{1}{4}$ th of an inch square, according to the character of the mark and the amount of material at my disposal, and digest it in three or four drops of water in a watch glass. If the solution became well coloured, I should not squeeze the material so much as to detach many minute particles of foreign matter; but if there appeared to be very little colour present, I should dissolve from it all I could, and take care to waste as little solution as possible, and have no more than would properly fill the cell. Transferring the solution to a cell about  $\frac{1}{2}$  inch long and  $\frac{1}{8}$ th inch in diameter, and having placed it horizontally in front of the slit and left it a short time, so that the minute particles of foreign matter might settle to the lower side of the tube, I should examine the spectrum, and carefully note the exact position and general characters of the absorption bands, if the solution were too strong diluting it until they were well seen. If the spectrum were like No. 2, I should feel nearly sure that the mark was due to blood; and if it had been kept dry in a town I should also conclude that it was nearly fresh. If it were as No. 4 I should feel inclined to believe that it had been exposed to the air for some time; but, unfortunately, the character of the atmosphere makes so much difference that no rule can be given. If, however, in any particular instance a knowledge of the length of time that had elapsed since the blood was fresh were of importance, a more definite opinion might be formed after a few days' experiment with fresh blood, keeping it, if possible, under the same conditions, and using the same material as in the case in question. If the spectrum obtained was like No. 4, I should add ammonia in excess so as to obtain one like No. 5, and afterwards add citric acid in excess so as to see spectrum No. 7. Then adding excess of ammonia and a small quantity of protosulphate of iron, stirring it to dissolve all the oxide, but not so much as to peroxidise and make the solution so yellow that it would not transmit the green, the spectrum No. 8 would be well seen, even when a very small quantity of blood had been present. If plenty of material remained, I should take another portion, dissolve the blood from it, add citrate of ammonia, taking great care that the solution was never acid, and then deoxidise by means of a little protosulphate of iron, so as to obtain No. 6; and I should also mount a dry specimen on glass, to keep as a permanent proof. If all the characteristic results followed, I think no one could hesitate in giving evidence that the mark was blood; though, of course, these facts alone would not decide whether or not it was human. If possible, that must be accomplished by other means, or a conclusion formed from other considerations.

If the quantity dissolved out at first gave a very faint spectrum, it would be well not to attempt to see the spectra Nos. 5, 6, 7, but to act on the solution with citric acid, filtering, if requisite, and then to add ammonia and protosulphate of iron, so as to obtain No. 8. The material itself might also have so acted on the blood that no other



spectrum could be seen. It is, however, so characteristic, that, even then, one could scarcely hesitate in deciding that the stain was due to blood.

If the material had evidently been washed, so that no spectrum could be obtained from a simple solution, having first ascertained what effect citric acid has on the dye, I should digest a stained portion in a solution of one-third or one-fourth of a grain of citric acid in a few drops of water, so as not to have more liquid than will fill the cell, filter, if requisite, add excess of ammonia, and then protosulphate of iron. Unless very thoroughly washed out whilst the blood was quite fresh, no mere washing with hot or cold water without brushing or other mechanical means being adopted to dislodge the minute insoluble particles, will so completely remove the stain that it could not be detected in this manner, except, indeed, any of those foreign substances be present which precipitate the colouring matter in a form insoluble in citric acid and ammonia.

Supposing a clear coloured solution be obtained, which gives a different spectrum or set of spectra to those characteristic of blood, it might be desirable to ascertain the nature of the substance to which they were really due. I have already described the spectra of a few colouring matters, but in all cases I strongly recommend the study of the spectra of any substances likely to occur in any particular instance. Even if blood has been detected this would also be desirable, since an opinion could then be given with more confidence.

My conclusion is, that, even in cases where the usual tests would fail, the detection of minute traces of blood need not in general be a weak point in the evidence of erime. Having proved it to be present, the question of its having been human or not must be decided by other considerations; and thus, as a positive proof, the evidence may be equivocal; but if a stain supposed to be due to blood, which, if it were, would certainly give the characteristic spectra, fail to do so, the negative evidence would be decisive.

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 28.

"On the Food of Man in relation to his Useful Work." By  
LYON PLAYFAIR, C.B., LL.D., F.R.S.

(Continued from page 248.)

#### DIVISION III.

#### Secretions as Measures of Work.

##### A. Secretion per vesicam.

27. WE have now to examine how far the secretions present us with measures of the work performed by the body. Commencing as we did in the first division of the lecture, it is necessary to inquire how far the urea secreted by a man living on a mere subsistence diet represents the amount of tissue which we have supposed to be wasted in internal dynamical work. Further on it will be seen that, in a man of good digestion, at least one-twelfth of the nitrogen of the food passes away in the fæces, without having been built into muscle or other tissue. Hence, of the 875 grains (2 oz.) of flesh-formers required to support *opus vitale*, 73 grains will pass out *per anum*, and 802 grains will be moulded into tissue, and be transformed into urea and the other products of wasted muscle. Hence, in the urine of a man supported by the lowest diet sufficient for life, we should still find 267 grains of urea. The same amount must appear in the

first days of starvation, during which life is supported by the wasting tissues; or what is the same thing, it will appear when non-nitrogenous food is taken. In Ranke's experiments upon himself, we find that, in the first case, he passed 17.02 grammes of urea, and in the second case 17.10 grammes.\* The mean gives 263 grains of urea—a number remarkably close to our calculated quantity, and probably identical, if the undetermined uric acid be accounted for. Beigel† during a three weeks' "hungercur" found the urea sink to 17.83 grammes, or 275 grains. A patient in the fifth week of typhus would possibly pass even less than 267 grains of urea, because part of the subsistence food, in the low state of dynamical vital work, would go to build up tissue; and accordingly we are not surprised to find that Brattler,‡ in the fifth week, found the urea as low as 16 grammes (247 grains). But when the patient becomes convalescent, and receives the standard diet for quietude—viz., 2.5 ounce of flesh-formers, he should then pass 335 grains of urea. Turning to the researches of Vogel§ and of S. Moos,|| we find that the secretion gradually rises from 22 grammes (336 grains) to the normal quantity of 35 grammes. Haughton¶ also states that convalescents in Hospitals pass about 300 grains of urea.

28. The experiments of the latter observer on the amount of urea secreted by average healthy men, living on a mixed diet, give from 660 to 580 grains. The mean of the extensive table of analyses in Parkes'\* excellent work is, however, only 512 grains. If we add to this his average for uric acid, in its equivalent of urea, we would have 521 grains. If, now, we take as a mean, for the present, the results of Barral,†† Valentin,‡‡ Vierordt,§§ and E. Smith,||| for the nitrogen in the fæces as being about one-eighth that in the urine (one-twelfth according to Ranke), then this, calculated as urea, would give  $521 + 65 = 586$  grains of an equivalent of urea. We can convert this into flesh-formers:—

$$586 \times 3 = 1758.$$

Now, 4 oz., or 1750 grains, form the usual diet of non-labouring men.

It will thus be seen that numbers closely approximating to the demand are obtained from recognised averages. But in order to apply them to the special class of healthy men (soldiers) described in Table II., we must take the diet as there given. Soldiers during peace are supposed to be well exercised by a daily march of seven miles. This march represents work equal to 38,333 metre kilos. If we take Haughton's mean of 575 grains of urea for such men, then the tissue transformed to produce this would be 3.94 oz., to which, using Ranke's proportion of one-twelfth of nitrogen in fæces, as we do for reasons hereafter to be stated, 0.33 oz. have to be added; making 4.27 oz. as against 4.21 oz. in Table I. Taking, then, 3.94 oz., we have:—

Potential energy in transformed tissue, 211,822 metre kilos.  
Useful external work, . . . . . 38,333 "

But as the former number includes the energy required to support *opus vitale*, we obtain the amount available for external dynamical work by subtracting it:—

$$211,822 - 107,524 = 104,298 \text{ metre kilos.}$$

Hence we have still nearly three times as much force available as is represented by useful work; but we need not be surprised at this when we know that the healthy soldier is capable of more exertion than he takes in peace.

\* Müller's Archiv. 1862, S. 358.

† Nov. Acta. Acad. Nat. Curios. xxv.

‡ Ein Beitrag zur Urologie, 1858, p. 19.

§ Zeitschr. f. rat. Med., iv., p. 362, et seq.

|| Idem, vii., p. 291.

¶ Urine of Healthy Men, p. 30.

\*\* Parkes on Urine, p. 15.

†† Comptes Rend., xxviii., 361. Ann. de Ch. et Phys. [3], xxv., 129, 171.

‡‡ Text-Book of Phys. 326.

§§ Vierordt, Phys. 197.

||| Phil. Trans., v. 151, p. 747, et seq.



29. Passing from our standard man in health to a hard-worked labourer, we can readily calculate how much urea should be produced by his plastic food. We obtain the amount which is transformed from tissue by deducting that which passes away as fæces :—

$$2406 - \frac{2406}{12} = 2205.5 \text{ grains.}$$

Without any error worth taking into account, the urea may be obtained by dividing this number by 3 (the correct number is 3.01); hence the working man, doing really a hard day's labour, should have 735 grains of urea in his urine, including its equivalent of uric acid. There are very few estimates of the urine of hard-worked labourers, and I have found it no easy matter to induce them to be made the subject of experiment. Nevertheless, in conjunction with my friend Dr. A. Dalzell, I have estimated the amount of urea in the urine on hard-worked labourers, and we are still continuing our inquiries on this subject. Before alluding to them, it will be more convenient to consider Dr. E. Smith's<sup>¶¶</sup> researches of weavers and tailors. The two weavers were engaged in "the very laborious occupation of wide-width cocoa-matting." Applying my tables to the recorded food of these men, I find that they received a daily supply of 5.33 oz., or 2333 grains of plastic nutriment, containing 366 grains of nitrogen. As an average of twenty-six days' experiment they gave :—

702.9 grains of urea, containing . 328.0 grs. nitrog.  
8.52 oz. fæces, containing . . 40.93 "

Total nitrogen . . . 368.93 "

As this differs by only three grains from the nitrogen of the ingesta, as determined independently of the experiment, the latter has obviously been done with great care.

The tailors, who were fully fed, received 4.63 oz. flesh-formers, according to my tables, containing 318 grains of nitrogen, and as an average of twenty-six days gave in egesta :—

608.4 grains of urea, containing . 283.7 grs. nitrog.  
6.98 oz. fæces, containing . . 26.43 "

Total nitrogen . . . 311.13 "

These tailors were, however, overfed; for while the weavers slightly lost weight, the tailors gained about 16 oz. each during the experiment. The lesser quantity of urea in this case was a necessary result of diminished food and work as compared with the weavers.

A distinguished colleague in my University, Professor Christison, whose knowledge as a chemist does not require to be referred to, had long since the idea that work, with corresponding food, increased the urea. When he was twenty-eight years of age and remarkably vigorous, he worked for two days as a carpenter to try this problem, and in addition walked on each of these two days ten miles, at a pace of nearly five miles per hour. As a mean of the two days, he passed 845 grains of urea; but, as the process of analysis was not then by the mercury method, we may reduce it, to make it comparable to our present standard, to 800 grains. But perhaps this may be too large a deduction, as we find that Hammond, exercising himself in a similar hard way, passed 865 grains.

We may compare these instances with those recently determined in my laboratory, and which were generally made on two men in each occupation for at least two days :

Hammermen . . . .	530 grains.
Quarrymen . . . .	550 "
Tailors . . . .	608 "
Weavers . . . .	303 "
Blacksmiths . . . .	695 "
Forgemen . . . .	740 "
Hard-working—pedestrian . . . .	800 "

¶¶ Phil. Trans., v. 151, p. 747, et seq.

The work of the two first set of workmen is fatiguing, but not laborious. The work of a hammerer (9) is 480,000 foot-pounds, which is within the capability of a fairly fed man with 4.2 oz. of plastic food. The difficulty of getting working men to understand the value of such inquiries has considerably retarded these determinations. In the case of the two blacksmiths, the difference between the urea of Sunday and labouring days is instructive :—

	Sundays.	Labour Days.
H.	{ 1. 38.56 grammes. 2. 34.47 "	{ 1. 41.38 grammes. 2. 46.69 "
Mean,	36.51	44.03
M.	{ 1. 31.42 grammes. 2. 31.06 "	{ 1. 40.61 grammes. 2. 49.08 "
Mean,	31.24	44.84

H. on the Saturday evening previous to the first Sunday had killed a pig and made merry with his friends—having, in fact, been drunk; hence that day's urine was probably deranged. Taking the mean, then, of the three observations, we have for

	Grammes.	Grains.
Sundays, or days of rest . . .	32.32	499
Week-days, or days of labour . .	44.43	686

The difference between 686 and 695, as given in the table, is for the equivalent of uric acid.

30. It will be seen that the demand of 730 grains of urea for a man doing the hard work of 790,000 foot-pounds is not beyond what is found in many cases. In fact, it follows as a necessity, if Tables III., IV., and V. are correct returns of the food of men engaged in labour. The researches of Lehmann\* and Ranke† have shown, that when much nitrogenous food is taken, an increase in the amount of urea follows. If, then, the plastic food of the adult man stands to the hard-worked labourer as 4.2 : 5.5, the urea must increase in nearly like proportion. There is now no longer any question that all the nitrogen of the ingesta is to be found again in the urine and fæces. Bischof and Voit‡ have proved this for dogs; Henneberg§ for cows; Voit|| for dogs and pigeons; Lehmann¶ for pigs; Ranke\*\* and Smith†† for men. As this is now determined beyond doubt, it scarcely needed new experiments to prove that a labourer, eating more food than a man not working, must pass more urea than the latter. The dispute as to the effects of *luxus consumption* involved the decision of this as the common battle-field for the disputants on both sides. Thus Beigil‡‡ found a secretion of 711 grains of urea in the case of men, when they had lived on animal food and rested, and 806 grains, under the same conditions, when they had active work. Becher found 729 grains, Lehmann 798 grains, and Ranke 1330 grains under like conditions. We need not, therefore, discuss the *questio vexata* as to whether albumen may or may not pass directly into urea, when in excess in the blood, without being built into tissue, for this is not the normal mode of nutrition. *Luxus consumption* may be a question to discuss when considering aldermanic dinners, but it can have no meaning when applied to the hard fare of the artisan, who takes no more food than is necessary for his work. The discussion, also, as to whether exercise increases the elimination of urea has little further interest for us, when we find such men as Lehmann,§§

\* Phys. Chem., ii., p. 450.

† Ranke, Müller's Archiv., 1862.

‡ Ernährung des Fleischfressers, 1860.

§ Quoted by Voit, *infra*.

|| Stickstoff-Kreislauf. Ann. des Ch. und Phar., 1863; Supp. Bd. 238.

¶ Zoochemie.

\*\* Op. cit.

†† Phil. Trans., 1862.

‡‡ Day's Phys. Chem., p. 43.

§§ Phys. Chem., Bd. ii., 449.



Hammond,||| Beigil,¶¶ Speck,\* Franque,† and Beneke,‡ deciding in favour of the fact that it is increased, against the varying experiments of Voit§ and the younger Draper|| on the other side. Dr. E. Smith has explained much of the anomalies of the latter physiologists, by showing that the period of the production of urea is not necessarily its period of elimination.¶ In most of the experiments made on this subject, the heavy exercise has been taken, not with the corresponding diet, but with the old diet, and under such circumstances the increased elimination of urea from the system is sometimes retarded two days. Hammond's experiments, even upon the same diet, were, however, very conclusive. His results are as follow:—

	Urea.	Uric acid.
With no exercise . . .	487.0 grs.	24.9 grs.
Moderate „ . . .	682.1 „	13.7 „
Hard „ . . .	865.0 „	8.2 „

31. When a large amount of animal diet is the chief source of food, exercise becomes a necessity, in order to waste the tissues for the support of respiration and other vital movements. Without it the animal soon loathes the food. This is not only the experience of carnivora, but also of man. Darwin tells us that, when in the Pampas, he lived tolerably well on a meat diet, "but felt that it would only agree with me with hard exercise;" and he tells us that the Guachos, who live upon meat, eat largely of fat, probably not only for respiratory food, but also as a protection against unnecessary muscular waste, as we have explained. Sir John Richardson observed the same fact in his Arctic travels, having noticed "that when people have fed a long time solely upon lean animal food, the desire for fat becomes so insatiable that they can consume a large quantity of unmixed, and even only fat, without nausea." The hyena in confinement wastes its tissues by moving backwards and forwards incessantly in its den, and thus is able to consume its animal diet. All this shows that the normal function of nutrition is to build its plastic food into tissues, to be transformed by internal and external dynamical work into carbonic acid, water, and urea.

32. We have confined our attention chiefly to urea, because, as a representative of dynamical labour, it is not mixed up with any other kind of work, such as *opus calorificum*. Carbonic acid is a marked product of work, but then it represents the sum of two factors,—increase in dynamical and in respiratory action. Thus, a labourer, living upon our standard diet, exhales in eighteen hours' quietude, and six hours' hard work, the following quantities of carbon, in the form of carbonic acid, after deducting the carbon in urea and in faeces:—\*\*

In 18 hours' quietude, 2375 grs. of carbon.  
„ 6 „ labour, 3212 „ „

In one hour's work, 535 grains of carbon are exhaled as carbonic acid, of which nearly one-fourth, or 135 grains, is due to the transformation of tissue, and the rest to the increased demand of the oxygen inspired for non-nitrogenous food.

||| *Amer. Journ. Med. Soc.*, 1855 and 1856.

¶¶ Ueber die Harn, etc., S. 42.

\* *Archiv. des Vereins für Wiss. Heilk.* Bd. iv., 484, and Bd. vi., 161.

† Schmidt's Jahrbuch, 1856.

‡ Nord, See Bad., 1855, p. 83.

§ Unters. über den Einfluss der Muskelbewegung, etc., 148, et seq.

¶ *New York Jour. Med.*, 1856.

¶¶ The experiments of E. Smith upon prisoners working on the treadmill are perhaps the most difficult to explain, for with this heavy work there was only an increase of sixteen grains daily. They worked every alternate day, but clearly under abnormal conditions, for "their muscular system was overworked and underfed." Their food, I find, contained daily 250 grains of nitrogen, while their urine and faeces contained 280 grains. Hence the working experiment was not one of health.

\*\* 220 grains of carbon are allowed for faeces, and all of which is deducted from the six hours' labour.

#### B.—Assimilative Work, as Measured by the Secretions per Annum.

33. The measure of the digestive or assimilative work in a man of healthy digestion is, I believe, to be found in the nitrogen of the faeces.†† Although the alvine evacuation frequently does contain undigested food, either in cases of over-eating or of indigestion, in full health, it is difficult to find with the microscope even traces of unchanged food. Bischof and Voit could not detect any muscular fibres in the faeces of the dog, and not even fat, when that had been purposely added to the meat. Rawitz‡‡ and other observers are of the same opinion. Hence the common notion that faeces represent the refuse of food is not supported by correct observation. Undoubtedly they contain various ingredients, nitrogenous as well as non-nitrogenous, mixed with mineral matter (Marcet).§§

34. The average weight of faeces secreted in health is 4.6 oz., according to Wehsarg|||, or 5½ oz. (Liebig). In Ranke's¶¶ experiments, on a mixed diet, the nitrogen excreted by the faeces is to that in the urine as 1 : 12.5. We take one-twelfth as the amount in health. But although this is the case in man, it is not so with regard to the carnivora. In Pettenkoffer's experiments with a flesh-fed dog, the nitrogen in the faeces was to that in the urine as 1 : 72; and in the still more extensive experiments of Bischof and Voit, as 1 : 76. But the ratio\* alters when fat or starch is added to the flesh; in the first case it is as 1 : 41, and in the second 1 : 40. When the dog was fed on flesh and sugar, it was as 1 : 23.3, and on starch alone the proportion became reversed, and then the nitrogen in the faeces was to that in the urine as 2 : 1. A little consideration will explain these differences. There are four fluids engaged in the promotion of digestion. All of them contain albuminous ferments, which receive special names, as pepsin when in gastric juice, ptyalin when in saliva, pancreatine in pancreatic juice, and intestinal ferment in the juice of the intestines. But we know nothing more of their chemical composition than that they are albuminous bodies, slightly oxygenised, and in the process of change. We do know that they have different actions,—pepsin acting on albuminous bodies, ptyalin and pancreatine converting starch into sugar, and the latter fat into its acids and glycerine; but in all probability the same ferments in different conditions produce their varying effects, just as we find the gastric ferment also able to act upon fats as well as on flesh-formers†, and the intestinal ferment combining the functions of the salivary, gastric, and pancreatic ferments. In fact, experiment tells us that alkaline gastric juice acts like pancreatic juice, and the latter, when acidified, plays the part of the former.

Referring to the proportion of nitrogen in the urine to that in the faeces of the carnivora, it is now possible to explain the apparent anomaly, that the addition of non-

†† It is only as this lecture passes through the press that I observe Marcet has given the same view, without, however, working it out. Not having found any such views in his two papers on faeces, I did not think of looking at his lecture on the chemistry of digestion till the last moment. The passage to which I refer is as follows:—"The principal object of the alvine evacuation is obviously to rid the body of certain parts of the intestinal secretions which, after having served their purpose in effecting the digestion of food, are not fit to return to the blood."—*Jour. Ch. Soc.*, xv., 418.

‡‡ Ueber die Einfach Nahrung Mittel.

§§ *Phil. Trans.*, 1854 and 1857.

||| Mikros. Und. Chem. Untersuchg. des Fæces, 1853.

¶¶ *Op. Cit.*, p. 311.

\* These numbers are relative, not absolute. The faeces of flesh diet contained 6.5, of starch 4.4, of sugar 7.9 per cent. of nitrogen; but the proportions of nitrogen in urine to nitrogen in faeces are as given in the text. Thus we find, on summing up the quantities, that the nitrogen in urine and in faeces, on a diet of flesh and sugar, is, in grammes, as 85.22 : 3.65; on flesh, starch, and fat, as 101.46 : 2.57; and on starch alone as 5.68 : 10.26. I have omitted the faeces on bread diet, for they seem to have been chiefly undigested bread.—(Ernährung des Fleischfressers.)

† Marcet, Chemistry of Digestion, Chem. Soc. Jour.,



nitrogenous aliments to the diet increased, instead of diminishing, the amount of that element in the fæces. When the animal is fed on flesh free from fat, the gastric ferment alone is brought into activity, aided partially perhaps by the intestinal ferment, and the residue of these appear in the fæces, which are found to contain but little nitrogen. When fat is now added to the diet, a large amount of pancreatic juice is brought into activity, and the used-up ferment of this juice is added to that of the gastric and intestinal juices as before. Hence we find that the proportion of nitrogen in the fæces is increased. When starch is mixed with the flesh, then the salivary ferment co-operates with the other three ferments in preparing the food for assimilation, and we find the proportion of nitrogen rather greater than before. When a carnivorous animal is placed in such an anomalous position as in feeding it on starch alone a much larger quantity of salivary, pancreatic, and intestinal ferments appear to be called into action to digest this unusual and unmixed diet, and hence the amount of nitrogen in the fæces becomes increased to an unusual amount.

35. The usual amount of nitrogen in the fæces of man is 6.5 per cent. in dry and 1.7 in fresh excrement; while the carbon is from 43 to 44 per cent. in the former. This is almost identical with the composition of normal fæces in the carnivora. The reason obviously is, that the changed albuminous ferments which form the nitrogenous constituents of fæces in health are the same in both classes of animals. Just as yeast loses some of its nitrogen by work, as emulsin becomes poorer in nitrogen and richer in oxygen when it has ceased to act on amygdalin, so do these different forms of albumen in their degradation suffer like changes. A well-known experiment of Lehmann is instructive on the subject under consideration. When emulsin (the casein of sweet almonds) is introduced with amygdalin into the stomach of an animal, the well-known fermentation by which that body is converted into oil of bitter almonds and prussic acid takes place, and the animal dies. On the other hand, when emulsin alone is introduced to the stomach, and amygdalin is injected to the blood, the animal does not suffer by the experiment. But upon reversing the mode of administration, and injecting the emulsin to the blood and putting the amygdalin into the stomach, the animal dies as before. Hence, we find that the ferment, after acting upon the substances which it met with in the intestines, could not be absorbed, for had it been it would have met with amygdalin in the blood, and would have produced fatal effects. That it had acted as a ferment upon the materials in process of digestion and had become exhausted is certain, for it altogether changed in its passage, the fæces of the animal not containing any emulsin capable of acting upon fresh portions of amygdalin. No experiment could be more conclusive for our views, because emulsin is simply changed casein, as these digestive ferments are changed albumen, each having certain peculiarities of action, according to the alkaline or acid fluids with which they act, or with other varying conditions.

36. Let us now return to the proportion of nitrogen found in the alvine dejections of man; it stands in relation to that in the urine as 1 : 12. Where it is present in larger proportions than this, then the excess is probably due to undigested flesh or to an excessive secretion of ferments necessary to overcome some digestive difficulty. In other words, one-twelfth of all the plastic food taken by a man is converted into digestive ferments, and this is excreted *per anum*.

I am not inclined to agree with those physiologists† who consider that these ferments secreted from the blood are the degraded products of tissue-waste in their passage to urica. On the contrary, I believe them merely to be albumen of the blood, the oxygenation of which is incipient, so as

to make it ready to build up tissue, as in its passage to fibrin.§ Hence, when there is an extensive demand on the blood for tissue material, as in the case of work in excess of the food supplied (for instance, as observed by E. Smith with his overworked prisoners), then the amount of the alvine dejection diminishes. These digestive ferments secreted from the blood cannot be albuminous materials in a downward career, otherwise their surplus, beyond that required for fermentation, would not again be absorbed into the nutrient fluid. It is only a small portion of the whole that is rendered unfit for re-absorption and is reduced to a degraded condition. If the great bulk of what is generally esteemed to be the ferments were not taken back into the blood, the amount of nitrogenous matter in the alvine dejections must be much greater than we find to be the case. Let us take very moderate computations as to the quantities of digestive juices secreted in twenty-four hours by a standard man, and this re-absorption will appear to be a necessity :—

1.6 kilog. of saliva,	contains	2.4 grammes	ptyaline.
6.4 „ gastric juice¶	„	20.5 „	pepsin.
4.0 „ pancreatic**	„	50.8 „	pancreatin.
0.2 „ intestinal††	„	1.8 „	ferment.

Total . . . 75.5 grammes.

Now as the whole fæces contain only 9.4 grammes of these exhausted ferments, it is obvious enough that the larger quantity represented above cannot consist of degraded matter in its descending career. When it is further borne in mind that the daily waste of tissues in a healthy man is only 112 grammes, it is impossible for us to suppose that more than half that quantity of degraded matter is preserved in the blood, to be excreted and then re-absorbed. This view would be quite inconsistent with the admirable arrangements of the excretory organs for speedily carrying off used-up matter from the nutrient fluid.

The functions of these digestive secretions must be considered as assimilative in the largest sense of the term. Chemical affinity generally is assimilative effort. When hydrogen unites with oxygen, each element endeavours to assimilate the chemical characters of the other element to itself, and when they are equal in power neutrality results. These ferments, as they are termed, when secreted in the digestive fluids, are albuminous substances changed and fitted for assimilation in the body, and capable of preparing the ingested food to assume their own state. They meet with resistance, which their large mass enables them to overcome, but a small portion of them succumb in the conflict, and are finally excreted in the alvine dejections, along with certain non-nitrogenous materials, which have probably been used in co-operation with them to fit the calorific constituents of food for absorption into the blood.

## ACADEMY OF SCIENCES.

May 22, 1865.

ANOTHER extract from the memoir of M. Persoz "*On the Molecular State of Bodies*" was read. The extract treats of the equivalent volumes of solid bodies, and the variations they undergo under the influence of heat.

A communication by M. Jaillard was read "*On some Derivatives of Toluidine*." The author has found that toluidine or toluyamine, like ammonia, will give rise to

§ Smee, *R. S. Proc.*, xii., 399, 405.

|| Dalton's "*Human Phys.*," p. 96.

¶ Katherine Kutt, the Esthonian peasant, with a gastric fistula, gave no less than 30 lbs. daily: the usual estimate, however, from researches on dogs, and applying them to man, is 14 lbs.

\*\* The estimates on this subject vary enormously, some going as high as 15 lbs. for a standard man. I have therefore taken a low estimate, nearly that of Bernard, who has devoted so much study to the pancreas.

†† I allow this for intestinal juice, from the experiments of Bidder and Schmidt.

† Draper's *Human Physiology*, p. 84.



amides, which vary according to the acids by means of which they are obtained, and which may be classed as mono-, bi-, tri-, &c., toluidides. The toluidic monamines may be prepared in the same way as the ammoniacal monamides by means of chlorides of monatomic acid radicals, and the author has formed aceto-, butyro-, valero-acid benzotoluidides. These bodies differ only in a few unimportant particulars. Toluylamine, however, differs altogether from ammonia in its behaviour with aldehydes, uniting with hydride of salicyl, for example, in the equal equivalent proportions. But with the sulphuretted essential oils (essence of mustard, for example), toluidine again behaves like ammonia. The author regards toluidine as a nitride of toluenyle and hydrogen, and names the derivatives on the same plan.

M. Georges Delvaux presented a note "*On the Action of Chromic Acid on Aniline.*" Two parts of aniline added to one part of chromic acid dissolved in eighteen or twenty parts of water forms after a time a deep brown precipitate. After digesting two or three days the precipitate may be separated by filtration; and then on treating it with boiling water a solution is obtained which dyes silk or wool a light violet red. On adding ammonia or carbonate of soda to the cold solution, a liquor is obtained, after filtration, which dyes silk and wool a yellowish red without any violet shade. The part insoluble in water appears to contain violet. The fact that this colour is soluble in alkalis without becoming decolorised seems to indicate that it is not a salt of rosaniline—an opinion which is supported by the circumstance that it is soluble in benzole. Strong hydrochloric acid also dissolves it, taking a green colour; but on the addition of water the red is restored. It dissolves in dilute hydrochloric acid, keeping its red colour.

M. Duchemin, whose "*Modifications of Bunsen's Battery*" we have noticed, wrote to say that crude chloride of potassium used in place of chloride of sodium, as he suggested in his last communication, considerably increases the power of the battery.

These were the only communications relating to chemistry read at the meeting.

## NOTICES OF BOOKS.

*For and Against Tobacco; or Tobacco in its Relations to the Health of Individuals and Communities.* By B. W. RICHARDSON, M.A., M.D., &c. London: Churchill and Sons. 1865.

THIS is, on the whole, a fair and dispassionate statement of the case for and against tobacco, and deserves the careful perusal of all devoted to the weed. Every reader of the CHEMICAL NEWS knows what happens when tobacco is burnt in a pipe or as a cigar, and we need not stop to notice the composition of tobacco smoke. Many too, no doubt, have felt "the first effects of tobacco on the body," to which Dr. Richardson devotes his next chapter, and will agree with him that these effects are by no means pleasant, and wonder to themselves however they came to continue the indulgence. But as they have continued it, it is well that they should know the worst about the consequences, and we accordingly condense a part of the author's summary. All the evils of smoking, he says, are functional in character, and no confirmed smoker so long as he indulges in the habit can ever be said to be well. But it does not follow that he is to become the subject of organic or fatal disease because he smokes. Smoking produces disturbances in the blood, on the stomach, on the heart, on the organs of sense, on the brain, on the mucous membrane of the mouth and throat, and on the bronchial surface of the lungs. The statement that tobacco smoke causes specific diseases, such as insanity, epilepsy, consumption, and chronic bronchitis, Dr. Richardson considers as devoid of truth. There is one affection, however—the atrophy of the optic nerve—said to be pro-

duced by tobacco smoking, of which the author has not taken sufficient notice. This effect of smoking, first pointed out by Mr. Wordsworth, was at one time strongly questioned; but more extended observation seems to have confirmed the dependence of the disease on tobacco, and we believe that now all the leading ophthalmologists in Europe admit the existence of tobacco amaurosis. It does not follow, Dr. Richardson would say, that every smoker will become amaurotic; but still he ought to be told plainly the risk he runs; and we hope the author will give much more space to this part of his subject in another edition of his pamphlet.

We will make two more short quotations. "Put down the smokers in Great Britain at a million. . . . Why should a million of men be living with stomachs that only partially digest, hearts that labour unnaturally, and blood that is not fully oxidised? In a purely philosophical point of view, the question admits but of one answer—viz., that the existence of such a million of imperfectly working living organisms is a national absurdity—a picture suggesting a mania, foolish, ridiculous, and incomprehensible." And yet Dr. Richardson considers tobacco "the least harmful of luxuries." "It is innocuous," he says, "as compared with alcohol; it does infinitely less harm than opium; it is in no sense worse than tea and sugar; and by the side of high living altogether it contrasts most favourably." From these two somewhat opposed statements, the reader must draw his own conclusions for or against tobacco.

*Chemisches Central Blatt.* Nos. 20 and 21. 1865.

THESE two numbers contain very little that has not already been noticed. In No. 20 we find "*A Method of Distinguishing between Cotton and Linen in Mixed Fabrics,*" by Böttger. He cuts a strip of the fabric three or four inches long and one and a-half wide, and draws out the threads at the corners so as to expose the warp and the weft. He then dips the ends into a weak alcoholic solution of aniline red, washes with common water until the washings are colourless, and now places the strip, while moist, in ordinary solution of ammonia, by which the colour will be discharged from the cotton, while the linen will remain red. At the corners where the threads have been loosened, the individual cotton threads will in a short time be seen quite white, and the linen a beautiful rose red.

The only novelty we find in No. 21 is a form for spiritus chlorato-ethereus, which will be noticed among our Miscellanea.

## NOTICES OF PATENTS.

1709. *Manufacture of Paints.* G. W. WEBBE and F. CAUT, Croxted Road, Dulwich. Dated July 9, 1864. (Not proceeded with.)

1729. *Manufacture of Pigments.* L. SCHAD, Hesse Cassel. Dated July 12, 1864.

THE first of these specifications describes the use of gas tar, or melted pitch and bitumen, as vehicles for a variety of metallic oxides and pigments when employed for coating surfaces after the manner of paint. It is intended to use only such colours as will withstand the action of heat, and those which cannot be injuriously affected by the sombre tint of the proposed vehicle.

The invention described under the second heading consists in the employment of manganate of baryta as a pigment under the name of "Cassel green." This new compound is prepared by the action of heat upon mixtures of oxide of manganese with nitrate of baryta, or preferably by heating a mixture of

Nitrate of manganese	. . .	24 parts.
Nitrate of baryta	. . .	46 "
Sulphate of baryta	. . .	"



in a calcining furnace until the whole of the nitric acid is driven off, and the product assumes an uniform green colour. It is then ground in a mill, and applied as a water colour in union with five per cent. of gum arabic or dextrine. Kaolin may be used instead of sulphate of baryta, and in the same proportion as that above specified.

1727. *Apparatus for Calcining Bones, and for Reburning and Revivifying Animal Charcoal.* S. CAREY, East Ham, Essex. Dated July 12, 1864.

THE specification describes an improved form of retort, and mode of setting the same, in order to be enabled by such arrangement to conduct the reburning of animal charcoal, &c., as a continuous operation. The inventor uses a D-shaped clay retort of considerable length, and sets it across the furnace at an inclination of about thirty-two degrees, so that the granules of bone-black introduced at the upper extremity may descend by their own gravity, and be completely burnt or revived by the time they have reached a closed box placed beneath the lower end of the retort.

1759. *Preparation of Material for the Purification of Gas.* A. A. CROLL, Coleman Street, London. Dated July 14, 1864.

THE inventor acts upon sawdust, or other vegetable matter in a fine state of division, with concentrated sulphuric acid in such a manner as to induce the carbonisation of the woody fibre. The blackened material thus obtained is very effectual in absorbing ammonia and other gaseous impurities contained in foul coal-gas, and the saturated product could be made available for the manufacture of artificial manures.

1766. *Manufacture of Fluoride of Silicium.* R. A. BROOMAN, Fleet Street, London. A communication. Dated July 14, 1864.

INSTEAD of decomposing fluor spar with a strong acid in the presence of sand or other silicious mineral for the preparation of gaseous fluoride of silicium, the inventor prefers to heat the mixture of fluoride of calcium and sand with carbon for the purpose of deoxidising the silica.

1780. *Obtaining Hydraulic and other Cements from Residues or Wastes.* T. TWINDILLS, Wigan. Dated July 15, 1864.

THE inventor proposes to economise the waste products of the alkali, iron, and chromic manufactures, by employing these materials in the production of cements. They are to be intimately mixed with lime or chalk or clay, burnt in kilns, and afterwards ground to a fine powder. It would seem possible to make the blast furnace cinder and alkali waste react upon each other at a high temperature without the addition of basic mineral matters, such as lime or clay, and so prepare at once a cheap cement fit for many rough kinds of engineering constructions.

1804. *Composition for Protecting and Preserving Metals, such as Iron, Copper, and Zinc, used in the Construction of Ships.* H. E. F. DEBRIEU, Welbeck Street, Cavendish Square, London. Dated July 19, 1864.

THE composition herein described consists of a thoroughly incorporated mixture of one part of mineral pitch with three parts by weight of vulcanised india-rubber, applied warm to the surfaces of the metal.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1102. F. A. Abel, Woolwich, "Improvements in the preparation and treatment of gun-cotton."—Petition recorded April 20, 1865.

1126. E. S. Beaux and E. Pannifex, Rue de l'Isly, Paris, "A new process of tanning leather and other skins."—April 22, 1865.

1144. W. Clark, Chancery Lane, "Improvements in washing or steeping and bleaching textile or fibrous materials."—A communication from Messrs. Neyret, Orioli, and Fredet, Boulevard St. Martin, Paris.—April 24, 1865.

1184. A. Grainger, Hall Place, Kennington, and C. M. Girdler, Saville Row, Walworth Road, "Improvements in the production of portraits or likenesses on certain materials by means of photography."—April 27, 1865.

1220. A. H. Emerson and R. Fowler, Mildmay Park, Stoke Newington, "Improvements in the manufacture and application of glass and other vitreous compositions."—May 1, 1865.

1242. C. G. Lenk, Dresden, Saxony, "An improved process for purifying water."—May 3, 1865.

1263. S. Bennett, Church Terrace, East Lee, Kent, "Improvements in brewing, distillation, the production of vinegar, and the extract of malt and other grain."—May 5, 1865.

1266. J. Swindells, Wigan, Lancashire, "Improvements in the manufacture of coal gas."—May 6, 1865.

1274. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in safety lamps."—A communication from F. Sack, Sprockhoeval, near Elberfeld, Prussia.—May 8, 1865.

1278. J. C. C. Halkett, Cramond House, County of Mid Lothian, N.B., "An improved composition for coating iron or other vessels and for other similar purposes."—May 9, 1865.

1313. A. Parkes, Birmingham, "Improvements in the manufacture of parkesine of compounds of pyroxyline, and also solutions of pyroxyline, known as collodion."—May 11, 1865.

1391. H. Ransford, Brompton, Middlesex, "Improvements in treating rice and other grain for the manufacture of starch; also to prepare them for use as food and for other purposes."—May 12, 1865.

1361. G. Walton, Weardale Villa, Clapton, "Improvements in apparatus used in distilling hydrocarbons."—May 16, 1865.

#### NOTICES TO PROCEED.

112. A. J. Sax, Paris, "Impregnating air for hygienic or therapeutic purposes with the vapours or emanations arising from tar, creosote, or other suitable liquid antiseptic or anti-putrid substances, or disseminating in the air, for the said purposes, suitable pulverised substances."—Petition recorded Jan. 13, 1865.

132. H. J. Rogers, and J. M. Scholfield, Serle Street, Lincoln's Inn, "Improved means of closing the mouths of bottles or other vessels."—Jan. 16, 1865.

202. B. King, Rushmere, Ipswich, "Improvements in the manufacture of manure."—Jan. 23, 1865.

263. F. A. Laurent and J. Casthelaz, Paris, "Improvements in the manufacture of benzoic acid."—Jan. 30, 1865.

315. R. A. Brooman, Fleet Street, London, "An improved varnish for preserving wood, and for protecting iron ships and other metal work from oxidation and from fouling."—A communication from A. Guibert, Paris.—Feb. 4, 1865.

448. J. F. Hersey, Park Place, Brompton, "Improved apparatus for measuring the specific gravity of liquids."—A communication from E. Payne, Montreal, Canada.—Feb. 16, 1865.

#### CORRESPONDENCE.

##### Continental Science.

PARIS, May 30.

AN account of the great storm which broke over the valley of Escaut on the 7th of this month, communicated to the Academy by M. Lermoyer, seems to me to deserve notice,



since I never remember having read of any fall of hail at all equal to what seems to have fallen on this occasion. The mass of stones which accumulated on the ground was soon sufficient to obstruct the course of the water from the torrents of rain which also fell, and the two formed a rolling wave, at least two metres in height, that rushed down the slopes of the valley, carrying everything before it. The canal that receives the drainage was completely obstructed by an enormous pile of charcoal which was swept into it. The next day M. Lermoyer found in the bed a deposit of hailstones 460 metres long, 20 metres wide, and in places more than 5 metres deep, thus forming a mass of more than 40,000 cubic metres, so compact that the water passing over it did not diminish the thickness one millimetre in twenty-four hours. It was, in fact, a solid glacier, on which he could walk with safety. Further on he found the ground covered (for 2 kilometres) with a bank of hailstones 200 metres wide, which must have contained 600,000 cubic metres, and which had not disappeared six days after the storm. No hail fell on this spot, and this enormous deposit consisted of stones brought by the floods and arrested by the banks, hedges, trees, and cottages. The devastation committed by the storm is immense; the crops, to translate literally, are completely hashed up, and, in fact, the whole soil has been washed away.

I find in *Les Mondes* an extract from the report of the Government Commission appointed to examine Dr. Louval's process for the preservation of corn, flour, and biscuits. Everybody knows what these are exposed to. Flour will, under some circumstances, heat and turn sour, weevils and cockroaches will attack biscuits, and rats and mice will seriously diminish the profits of the farmer if he will allow them. Dr. Louval's plan is remarkably simple. He puts the substances into iron cylinders and exhausts the air. Here, of course, they are safe from rats and mice; but is flour preserved from fermentation, and are biscuits kept free from weevils? The experiments of the Commission are most conclusive on these points. It is proved that weevils cannot exist in rarefied air, and that no fermentation can take place in the flour. It has been found also that in the particular apparatus devised by Dr. Louval a good vacuum can be maintained for six months, and the Commission therefore reports that the process is of a kind to render great service to commerce and the mercantile marine. Perhaps the process may be worthy the attention of our Government also; for if I remember rightly, the Clarence Yard, Portsmouth, is always familiarly spoken of by sailors as "Weevil."

I am tempted to make another extract from *Les Mondes*. It is from a letter by Father Hamy to the Editor, accompanying a translation of the article on Equivalents in Mr. Watts' Dictionary. The rev. gentleman speaks in the highest terms of this excellent work, and hopes the able Editor will make known "a dictionary so complete, so well executed, and calculated to be useful, not to say indispensable, to all who cultivate the glorious science of chemistry." Mr. Watts' friends—and they include all English chemists—will be pleased to learn that his work is so highly appreciated here.

### MISCELLANEOUS.

**The Case of Poisoning near Maidstone.**—We learn that the poison taken in this case was really nitrobenzole. What remained in the bottle was sent to Dr. Letheby for examination, and has been found to be pure nitrobenzole. It is only fair to the druggist who sold it to say that the bottle was distinctly labelled "Oil of almonds, for scenting pomatum;" but we think it would be safer to discontinue calling nitrobenzole, oil of almonds. Essence of Mirbane is more appropriate, and free from danger,

**Royal Institution.**—The following are the arrangements for the ensuing week:—Monday, June 5, at 2 o'clock, General monthly meeting. Tuesday, June 6, at 4 o'clock, Mr. Edwin Chadwick "On the Physical and Moral Condition of the English Wage Classes." Thursday, June 8, at 4 o'clock, M. Jules Simon "On the Physical and Moral Condition of the English Wage Classes." Friday, June 9, at 8 o'clock, Professor Frankland, F.R.S., "Latest Researches in Organic Chemistry." Saturday, June 10, at 4 o'clock, M. Jules Simon "On the Physical and Moral Condition of the English Wage Classes."

**Spiritus Chlorato-ethereus** is prepared by mixing in a retort three-quarters of a part of finely powdered bichromate of potash and one part commercial hydrochloric acid. To this is carefully added, so as to mix as little as possible with the acid, sixteen parts of the strongest spirit of wine. Heat is then applied, and fourteen parts distilled. The first ounce should be rejected; the remainder will be free from acid, and show, on the addition of nitrate of silver, only a trace of chlorine.—*Neues Jahrb. für Pharm.*, Feb., 1865.

**Use of Aniline Colours in Oil and Aquarelle Painting.**—Kletinsky dissolves the aniline colour in strongest alcohol, saturates this solution with Dammar resin, filters the tincture, and pours the filtrate either on pure water or solution of common salt, stirring well all the time. The water or solution must be at least twenty times the bulk of the tincture. The coloured matter separated can now be collected on a filter, washed, and dried. It can then be ground with linseed oil, poppy oil, or oil varnishes.—*Chem. Central-Blatt*, No. 13, 208.

**Discovery of Cannel Coal in New South Wales.**—Advices have been received, by the last overland mail, of the discovery, about 80 miles from Sydney, near a line of railway now in course of construction, of a workable seam of cannel coal, which surpasses the hitherto unrivalled Boghead in richness. Its yield per ton is reported to be 17,500 cubic feet of gas of 31-candle illuminating power, and .745 specific gravity. The discovery must exercise great influence on gas-lighting in Australia, the East Indies, China, California, and South America, by enabling the gas-works of those countries to use their inferior local coals, and bring up the quality of their gas to a satisfactory illuminating power by the addition of a small quantity of Australian cannel.—*Journal of Gas Lighting*.

### ANSWERS TO CORRESPONDENTS.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 12s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

Will appear in an early number, a lecture by Dr. Letheby, "On the Present State of the Chemistry of Gas-Lighting, chiefly in relation to the properties of the individual constituents of coal-gas, and the best means of consuming it for lighting and heating purposes."

W. B.—Dr. Odling's lectures will be begun in our next volume, and completed in the volume.

T. R.—Published by Baillière, Regent Street.

G.—Mr. Huggins' lecture will appear in our next.

X. Y.—The dose was excessive, and you were justified in applying to the writer of the prescription.

W. A.—The smallest dose of nitrobenzole that will kill has not been determined. The smaller the dose, the longer the symptoms are delayed. Dr. Letheby's paper will be found in the *Proceedings* of the Royal Society.

Received.—Dr. W. Bird Herapath; Wm. Herapath, sen.; Chas. Piesse.  
Book Received.—Pratt's Astronomical Investigations.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.

## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION II.—New System of Atomic Weights.

(Continued from page 182.)

**Discussion of Ampère's Law.**—All the arguments used to determine the molecular weights of volatile compounds have for their basis the law of Ampère, that equal volumes of gases or vapours contain the same number of molecules. It is admitted that the molecule of simple and compound bodies corresponds to 2 volumes, and that consequently the molecular weight was given by their double density in respect to hydrogen.

There are exceptions to this law. The molecules of perchloride of phosphorus, of hydriodate of phosphuretted hydrogen, of hydrochlorate and hydrocyanate of ammonia, of monohydrated sulphuric acid, and certain other combinations, correspond to 4 volumes of vapour; their molecular weights are expressed by four times their vapour densities compared with hydrogen.

MM. Hermann Kopp,\* Cannizzaro,† and Kekulé,‡ have proposed the following interpretation in order to bring these exceptions into the general rule. At the temperature at which the vapour densities of the preceding compounds are taken they decompose, and instead of being a homogeneous vapour, they consist, in fact, of a mixture of vapours. Thus, perchloride of phosphorus  $\text{PCl}_5$  splits up into protochloride  $\text{PCl}_3 = 2$  volumes, and into  $\text{Cl}_2 = 2$  volumes. Sal ammoniac  $\text{NH}_4\text{Cl}$  splits up into  $\text{HCl} = 2$  volumes and  $\text{NH}_3 = 2$  volumes; sulphuric acid  $\text{SH}_2\text{O}_4$  into  $\text{SO}_3 = 2$  volumes and  $\text{H}_2\text{O} = 2$  volumes, and the same for the other compounds. But this decomposition is not definite; when the temperature lowers the original combination becomes re-formed in such a manner that after the condensation of the vapour there no longer remains a trace of the dissociation § which it has undergone.

The idea is ingenious, but the demonstration is difficult. In fact, how can it be proved that the vapour of perchloride of phosphorus, for example, consists at  $300^\circ$  of a mixture of chlorine and protochloride? Shall the chlorine be absorbed by some body with which it can combine? Then another affinity comes into play, and however feeble this be, it may be thought that it plays an active part in the decomposition of perchloride of phosphorus. For this reason, M. Bunsen remarked that the question as to whether two gases existed in the state of combination or of mixture could only be settled by submitting these gases to physical tests. They might thus be allowed to diffuse into another gas—hydrogen,

for instance; if they were combined, they would pass through in the proportions in which they existed in the combination; if they were mixed, they would pass as if each were by itself in the inverse ratio of the square roots of their densities.

These experiments have been tried. M. Pebal || was the first to show that when the vapour of sal ammoniac is diffused into hydrogen, the ammonia, being less dense than the hydrochloric acid, passes through in greater quantity.

More recently, Messrs. Wanklyn and Robinson ¶ have found that when the vapour of hydrated sulphuric acid is allowed to diffuse into air through a very fine point, water escapes abundantly, whilst anhydrous sulphuric acid accumulates in the flask. Having in a second series of experiments substituted perchloride of phosphorus for sulphuric acid, they found that the flask after some time contained a small quantity of protochloride of phosphorus, the vapour of which, being denser than that of chlorine, diffused less easily. The accuracy of the hypothesis of MM. Hermann Kopp and Cannizzaro thus appeared to be demonstrated, but some new and important experiments of M. H. Deville \*\* have reopened the question.

This physicist found that the vapour of water would decompose in small quantity at a temperature lower than that developed by the combination of hydrogen with oxygen, and therefore much lower than that at which water would decompose in quantity. He assumed, therefore, that bodies possess at temperatures below their decomposing point a certain tendency to decompose—a tension of decomposition, as he expresses it. It is this nascent decomposition which he now calls dissociation. This is an apt interpretation of the experiments of MM. Pebal, Wanklyn, and Robinson. By virtue of their tension of decomposition, sal ammoniac, sulphuric acid, and protochloride of phosphorus undergo an incipient decomposition at the temperatures at which they vaporise, and it is these minute portions so dissociated which give rise to the phenomena of diffusion just mentioned.

This was an interpretation, but the following is an experiment which carries great weight:—††

Having led ammonia and hydrochloric acid into a flask heated by the vapour of mercury and furnished with an air thermometer, the temperature of the receptacle was seen to rise to  $394.5^\circ$  by the action of the combination of the two gases. M. Deville concluded from this that hydrochlorate of ammonia could exist in the state of vapour at the temperature of  $350^\circ$ , and even at  $390^\circ$ , and that this vapour does not consist of a mixture, but actually of a combination of the two gases—ammonia and hydrochloric acid.

Against this conclusion MM. Wanklyn and Robinson have raised the following objections:—As M. Deville passed the gas rapidly into the flask where they were to combine, nothing proves that at the moment of combination they had acquired the temperature of  $350^\circ$ . Therefore, being cooler than the receptacle, they were able to combine at a temperature below that which is needed for the dissociation of sal ammoniac; and this combination would, therefore, have produced an elevation of temperature. Quite true, replies M. Deville to this; but it must be remembered that the temperature

\* *Annalen der Chemie und Pharmacie*, cv. 390.

† *Nota sulle Condensazioni di Vapore*. An appendix to the above quoted work of M. Cannizzaro, *Sunto di un Corso di Filosofia Chimica*. Pisa. 1858.

‡ *Annalen der Chemie und Pharmacie*, cvi. 143.

§ The word dissociation is due to M. H. Deville (*Comptes Rendus*, xlv. 857, 1857). In its original sense it was almost synonymous with decomposition. More recently M. Deville has employed it to indicate that partial and gradual decomposition which bodies undergo when exposed to a temperature below that at which they decompose in bulk, and which is their true temperature of decomposition. I have proposed (*Répertoire de Chimie Pure*, ii. 37, 1863) to employ this appropriate term dissociation to characterise the temporary disjunction which certain bodies undergo at elevated temperatures into elements which are ready to recombine when the temperature becomes lowered.

|| *Annalen der Chemie und Pharmacie*, cxliii. 199, and *Annales de Chimie et de Physique*, 3rd series, lxvii. 93.

¶ *Comptes Rendus*, lvi. 547.

\*\* *Comptes Rendus*, lvi. 195.

†† *Comptes Rendus*, lvi., 193.



rose to  $394^{\circ}$ . The gases combine, therefore, at  $350^{\circ}$  with development of heat. It follows, therefore, that sal ammoniac is not dissociated at  $350^{\circ}$ , but that it really exists in the state of combination, and not in the state of mixture.

There can be no mistaking the force of these arguments.†† However, the ingenious theory of M. H. Deville—or rather, the conclusions which he draws from it—still leaves room for an objection which I shall next discuss.

(To be continued.)

*On the Action of Ammonia on Carbon at a Red Heat,*  
by Dr. G. LUNGE.

ALLOW me to make some remarks on a short paper by M. Weltzien—"The Formation of Cyanogen and the Action of Ammonia on Carbon at a Red Heat"—contained in the last number of the CHEMICAL NEWS.

It is stated therein, that according to M. Kuhlmann, ammonia acts on carbon, giving cyanide of ammonium and marsh gas; the author, however, believing that the reaction could not be so simple, and that ethylene and acetylene were formed at the same time, repeated the experiment, but failed in obtaining any carbonated hydrogen.

Now, I have worked on a large scale, for manufacturing purposes, the process of passing ammonia over red-hot charcoal. I collected the cyanide of ammonium in earthenware receivers, containing sometimes a solution of caustic soda, sometimes recently precipitated protoxide of iron and other unstable materials, in order to fix the cyanogen, then the ammonia was fixed by muriatic acid in similar receivers. The unabsorbed gas had to pass through one or two casks partially filled with water, the conducting pipes dipping into the latter; at last it went back to the heating furnace and was burnt there. An exhausting pump was working between the last cask and the furnace, as the earthenware pipes which contained the charcoal could not have withstood the pressure of so many columns of liquor in the different earthenware and wooden receivers. Most of the connecting pipes between the receivers were made of earthenware, only one or two of copper, just those in connexion with the wooden casks. No sooner had I commenced to work this apparatus, when I experienced daily violent explosions, some of which shattered the wooden casks to pieces, leaving the earthenware receivers intact. Every precaution had been taken against such an emergency, and I was quite at a loss to understand the cause of it until I met with a notice of spontaneous explosions in copper gas pipes from an American paper. Besides, it was already known then (1860) that illuminating gas, when passed through a solution of protochloride of copper, leaves therein a compound of detonating properties. (Acetylene itself was not then discovered—or, at least, M. Berthelot had not published his discovery.) Consequently I exchanged the copper pipes for iron ones, and the explosions ceased directly. Considering the circumstances, I have been led to believe that acetylene was formed in the above described process, and that this gas, coming in contact with the copper pipes, caused the explosions.

†† Another argument of M. H. Deville is this:—Hydrocyanate of ammonia is a very stable body; it forms at  $1000^{\circ}$ . It can, therefore, exist at this temperature, which is above that in which ammonia is decomposed into hydrogen and nitrogen. If, then, its vapour density is determined at  $100^{\circ}$ , it is found to correspond to four volumes. Can a body then be decomposed at  $100^{\circ}$  when it is capable of forming at  $1000^{\circ}$ ?

I think there is nothing extraordinary in this discrepancy of results, M. Weltzien working in a chemical laboratory, and I on a manufacturing scale, when many of the circumstances would be quite different, and the reactions likely to be more complicated.

Wolverhampton, June 5.

*On the Properties of Liquefied Hydrochloric Acid Gas,*  
by GEORGE GORE, Esq., F.R.S.\*

[THE apparatus employed and manipulation adopted in procuring liquid hydrochloric acid were similar to those by means of which the author procured liquid carbonic acid; and are described at length in the *Journal* of the Chemical Society, vol. xv., p. 163. The materials used to obtain the gas were strong sulphuric acid and fragments of sal ammoniac.]

The liquid acid is a very feeble conductor of electricity, but is not nearly so powerful an insulator as liquefied carbonic acid gas.

The following experiments illustrate its chemical, solvent, or other action upon various substances immersed in it. The quantity of the solid substances employed was in nearly all cases very small in proportion to that of the liquid acid in contact with them, and in many cases did not amount to one-twentieth of its volume.

A piece of charcoal remained unchanged at the end of ten days, the acid being in a liquid state in contact with it at intervals. A fragment of fused boracic acid did not lessen in bulk or alter in appearance in seven days. White phosphorus was undissolved and unchanged in nine days, and remained equally inflammable. A fragment of ordinary sulphur did not dissolve or alter in several days. Fragments of vitreous black selenium did not dissolve or change in six days. Iodine dissolved rather freely, and quickly formed a purple-red solution. A piece of pentachloride of phosphorus softened in the gaseous acid, and dissolved quickly and completely in the liquid acid, forming a colourless solution. A fragment of sesquicarbonate of ammonia swelled and became full of fissures in the gaseous acid, but neither evolved gas nor dissolved when the liquid acid came into contact with it; after three days' intermittent immersion in the liquid acid, the saline residue evolved no gas on immersion in dilute hydrochloric acid. A piece of sal ammoniac, immersed almost constantly during nine days, remained undissolved and unchanged.

Potassium evolved no gas when the liquid acid came into contact with it; after eight days it was sometimes enlarged in bulk, and from the outset it was of a white colour; it did not at all dissolve. In a second experiment the results were precisely similar; after three days' intermittent immersion the saline residue showed no signs of containing free potassium on immersing it in dilute hydrochloric acid. Anhydrous carbonate of potash in powder evolved no gas on first coming into contact with the liquid acid; after three days' occasional immersion it remained undissolved, and the residue evolved no carbonic acid on immersion in dilute hydrochloric acid. A crystal of chloride of potassium did not dissolve or change in appearance by four hours' immersion in the liquefied acid. Powdered chlorate of potash imparted a yellow colour to the liquid acid, and did not lessen in bulk during three days' constant immersion; the upper gutta-percha stopper became quite white at its inner end. A crystal of nitrate of potash became of a brownish colour

\* Abstract from *Proceedings of Royal Society*, p. 204.



before the gas liquefied, and remained undissolved after six days' intermittent immersion; the upper gutta-percha stopper was unusually acted upon, and of a nanken colour.

Sodium became white and swelled largely before the gas liquefied. No visible gas was evolved by it in the liquid acid. After three days' intermittent immersion the residue contained no sodium in the metallic state, and no portion of it imparted a blue colour to damp litmus paper. Anhydrous carbonate of soda in powder immersed one hour and a quarter in the liquid acid evolved no visible bubbles of gas, and lost its alkaline reaction (with litmus paper) to about three-fourths of its depth. A fragment of fused sulphide of sodium produced a slight sublimate of a yellowish-white colour. It evolved no visible gas in the liquefied acid.† After three days' variable immersion it was of a yellowish-white colour, and somewhat enlarged in bulk; the residue evolved no sulphuretted hydrogen by immersion in dilute hydrochloric acid, and its solution gave a perfectly white precipitate with acetate of lead, and imparted no dark colour to sulphate of copper.

Precipitated carbonate of baryta in powder evolved no visible gas by immersion in the liquid acid; it remained undissolved and unchanged in appearance during three days' immersion; the residue evolved a minute quantity of gas by contact with dilute hydrochloric acid. Precipitated carbonate of strontia in powder behaved like carbonate of baryta; the residue, after three days' immersion, was lost during the discharge. A minute fragment of anhydrous Bristol lime exhibited no solution or alteration by nearly constant immersion during eight days in the liquid acid. On removal from the tube, it imparted a strong blue colour to neutral litmus paper by slight friction. On fracture it was found similarly alkaline throughout, and exhibited a slight change of colour, extending from its surface to the centre, as if the gas or liquid had been forced into its pores. In a second experiment of three days' intermittent immersion, precisely similar effects were obtained. Several minute fragments of very soft marble were immersed in the liquid acid at intervals during seven days. No gas was evolved when the liquid touched them. On removal from the acid, their physical characters appeared unaltered; they were insoluble in water, but quickly dissolved in dilute hydrochloric acid, with copious evolution of gas. A fragment of bone-earth did not dissolve or alter in appearance during seven days.

Bright magnesium ribbon slowly became dull in the liquid acid without visible evolution of gas; after seven days' intermittent immersion it was still, with the exception of a thin film, in the metallic state. In a second experiment of three days' constant immersion similar effects occurred; the residue dissolved and floated in dilute sulphuric acid, with copious evolution of gas. A wire of magnesium and one of platinum immersed in the liquid acid, and connected with a sensitive galvanometer, evolved no perceptible electric current, and only a barely perceptible current after two days of constant immersion. Calcined magnesia in powder did not dissolve or alter in appearance during four days' nearly constant immersion. Oxide of cerium (containing some oxide of didymium and lanthanum) remained undissolved and unchanged in colour during nine days; the residue was insoluble in water. Metallic aluminium

became dull in the gas, and quickly dissolved, with evolution of gas, when the liquid acid came in contact with it, and formed a colourless solution. A wire of aluminium and one of platinum, immersed  $\frac{1}{9}$ th of an inch apart in the liquefied acid, and connected with a sensitive galvanometer, produced a steady deflection of  $12\frac{1}{2}$  degrees, the aluminium being positive. The deflection gradually increased to 17 degrees in one hour, and two layers of liquid formed, the lower one brown in colour, and the upper one nearly colourless. The conductivity of the liquid acid was probably increased by the metallic aluminium dissolved in it. Precipitated alumina did not visibly alter or dissolve during six days; the residue deliquesced in damp air. Precipitated silica in powder did not dissolve or visibly alter during four days. Precipitated titanate of potash in powder (pale flesh colour) slightly dissolved in seven days.

A fragment of fused tungstate of soda did not alter in bulk during ten days; it had then acquired a superficial green colour. Molybdic acid in powder turned dark green, but remained undissolved at the end of nine days. Native sulphide of molybdenum remained undissolved and apparently unchanged during two days. Molybdate of ammonia in powder became yellowish green in the gas; it became grass green in colour in the liquefied acid, but did not dissolve in four days. Sesquioxide of chromium in powder did not dissolve in six days, but became of a dull blackish-brown colour. A fragment of anhydrous yellow chromate of potash became red before the gas liquefied, but did not dissolve or otherwise alter in the liquid acid. Sesquioxide of uranium became of a pale yellow colour in the gas, but did not dissolve in the liquid acid in six days; the residue was entirely soluble in water. Precipitated black oxide of manganese in powder, and free from water, became quite white in the gas; it remained white in the liquid acid without evolving visible bubbles of gas, and did not lessen in bulk in seven days. A crystal of permanganate of potash softened and swelled in the liquid acid, but did not dissolve in five days; it remained of a dark colour; the residue, placed in distilled water, produced no colouration.

A crystal of metallic arsenic remained perfectly bright and unchanged in bulk during three days' immersion. Arsenious acid in powder quickly liquefied in the gas, and dissolved to a colourless solution in the liquid acid. A crystal of arsenic acid softened before the gas liquefied, and dissolved quickly and freely in the liquid acid to a colourless solution. Bisulphide of arsenic in powder did not dissolve in six days, but became slightly less red and more yellow; a slight yellowish-white sublimate occurred in the tube during the generation of the gas. Teriodide of arsenic in powder slightly dissolved to a purple-red liquid; apparently only a trace of its iodine was extracted, as its bulk was not visibly less in three days. A crystal of bright antimony remained perfectly bright and unchanged after nine days' intermittent immersion. Precipitated teroxide of antimony became partly liquid before the gas liquefied; it dissolved in the liquid acid quickly and rather freely, and made a colourless solution. A fragment of precipitated antimonious acid did not dissolve in six days. A fragment of black tersulphide of antimony evolved a film of yellowish-white sublimate, and lessened in bulk before the gas liquefied; it decomposed and dissolved in the liquid acid in about a quarter of an hour, and formed a colourless solution, which exhibited no further change during seven days. A fragment of bright metallic bismuth remained undissolved and unchanged in the liquid during three days.

† Probably the sulphuretted hydrogen set free was in a liquid state, and therefore no bubbles of gas appeared. I found by experiment that hydrochloric acid and hydrosulphuric acid, generated together and condensed into a liquid state, did not form two separate strata of liquid.



Bright zinc evolved no visible gas in the liquid acid, and was not perceptibly corroded in three days. Oxide of zinc slowly dissolved in seven days. Metallic cadmium evolved no gas in the liquid, and was not sensibly corroded in three days. Precipitated carbonate of cadmium evolved no visible gas in the liquid acid, and remained undissolved and unchanged in appearance during seven days. Yellow sulphide of cadmium evolved a trace of white sublimate before the gas liquefied; in the liquid acid it became quite white, and remained undissolved in seven days; on removal it was hard in texture and quite white throughout, and evolved no odour of sulphuretted hydrogen or separation of sulphur on treatment with strong nitric acid. Bright tin evolved no visible gas in the liquid acid; after ten days' intermittent immersion it was converted, to some depth of its substance, into a bulky white solid with deep fissures. In a second experiment of three days' immersion similar results occurred; all the tin was corroded except a minute fibre in the centre, the white solid was imperfectly soluble in water, but instantly soluble in dilute hydrochloric acid. Binoxide of tin in powder did not dissolve in seven days; the residue was white and insoluble in water. A crystal of protochloride of tin softened before the gas liquefied, and partly dissolved in the liquid acid in four days. Bright metallic thallium evolved no gas in the liquid acid, and was only superficially blackened without further corrosion after three days' immersion. Metallic lead did not evolve visible gas in the liquefied acid; it became blackened at first, and in ten days was corroded deeply to a white substance. Red oxide of lead quickly became white in the liquid acid, but did not dissolve in seven days; it was then quite hard, white throughout, and not readily soluble in water. Precipitated carbonate of lead evolved no visible gas in the liquid acid, and remained undissolved after three days' immersion; the residue evolved no gas by contact with dilute hydrochloric acid. Precipitated sulphide of lead in powder produced a faint film of white sublimate in the gas, and by a few hours' immersion in the liquid acid became wholly white; it did not dissolve during seven days, and was then quite white throughout, and not readily soluble in water. Yellow iodide of lead did not dissolve in seven days, but became of a purplish brick-brown colour and evolved a strong odour of free iodine; it produced yellowish-brown stains upon paper. Yellow chromate of lead evolved at first (in the gaseous acid) a small quantity of deep-red vapour, which condensed as a red moisture near it on the tube; the chromate became white in the gas, and did not dissolve in the liquid acid in three days; it was then a soft white solid, not freely soluble in water, and imparted a faint greenish tint to water.

A minute fragment of iron remained bright, and evolved no gas when the liquid acid came into contact with it; after nine days of intermittent immersion it was only slightly tarnished, and on removal from the acid was found otherwise unaltered. A fragment of fused sulphide of iron produced a faint film of whitish sublimate at first, but evolved no bubbles of gas on contact with the liquid acid; it did not dissolve or alter in appearance. A second fragment constantly immersed during three days behaved similarly; it was as hard as before immersion, and evolved sulphuretted hydrogen freely in hot dilute sulphuric acid. A crystal of green vitriol became yellowish white and opaque in the liquid acid, but did not diminish in volume in six days; the residue was a soft opaque yellowish-white solid. Oxide of cobalt in powder exhibited no change or solution

during three days; on removal it was found to be very hard, of a light-brown colour, and dissolved in water, producing a pink solution with separation of black oxide. Peach-coloured carbonate of cobalt evolved no visible gas in the liquid acid; it became greenish blue, but did not lessen in bulk in three days; the residue became pink in the air, and dissolved almost completely in water, forming a pink liquid; it also dissolved in dilute hydrochloric acid without evolving bubbles of gas. Anhydrous chloride of nickel did not dissolve in the liquid acid in six days. Metallic copper soon lost its brightness in the gas; it evolved no gas in the liquid acid, and was only slightly corroded after seven days. Black oxide of copper became of a lighter colour in the liquid acid, but did not lessen in bulk in seven days; the residue was a greenish and yellowish white powder, which instantly turned black in water, forming a pale-blue solution, and left black oxide of copper. A crystal of blue vitriol became of a light brown colour in the liquid acid, but did not dissolve in six days; on removal it was found to be a brown soft solid. Protoxide of mercury became white in the gas, and did not dissolve by constant immersion in the liquid acid in four days; the residue was a white solid soluble in water. Vermilion in powder slowly changed in the liquid acid in three days to a pinkish-white solid, but did not dissolve. Scarlet iodide of mercury in powder imparted a red colour to the liquid acid, but did not lessen in bulk or change in colour during three days; the residue lost its red colour on the application of heat. A fragment of protochloride of mercury did not visibly alter in the liquid acid in four days. Metallic silver did not dissolve or become much corroded during seven days. Oxide of silver became white in the liquid acid in one day, but not dissolve. Precipitated chloride of silver in powder did not visibly alter or dissolve during sixteen days. Metallic platinum was unaffected in the liquid acid.

Solid extract of litmus dissolved slightly, forming a faintly purple blue or inky solution; it became of a dark red colour, and enlarged in bulk; the residue formed a perfect solution in water; the solution was red colour,

**Remarks.**—The foregoing experiments show that liquid hydrochloric acid has but a feeble solvent power for solid bodies in general. Out of 86 solids it dissolved only 12, and some of those only in a minute degree; of 5 metalloids it dissolved 1—viz., iodine; of 15 metals it dissolved only 1—viz., aluminium; of 22 oxides it dissolved 5—viz., titanous acid, arsenious acid, arsenic acid, teroxide of antimony, and oxide of zinc; of 9 carbonates it dissolved none; of 8 sulphides it dissolved 1—viz., tersulphide of antimony; of 7 chlorides it dissolved 2—viz., pentachloride of phosphorus and protochloride of tin; and of 7 organic bodies it dissolved 2.

The results show also that liquid hydrochloric acid in the anhydrous state manifests much less chemical action upon solid bodies than the same acid when mixed with water as under ordinary circumstances; for instance, the difference of its action upon magnesium, zinc, cadmium, and even aluminium, under the two conditions, is very conspicuous. This may arise in a great measure from its feeble solvent capacity—insoluble films forming upon the surface of the bodies immersed in it preventing its continued contact and further action. This want of contact could hardly have been the case in the remarkable instance of caustic lime: here was a powerful and true acid (*i.e.*, a hydrogen acid) and a powerful base; each in a nearly pure state; both possessing under ordinary circumstances a very powerful chemical affinity



for each other; the one a liquid and the other a porous solid; the solid base being very small in bulk, and the liquid acid largely in excess, probably fifty times the quantity necessary for its saturation; and the action extended over a far greater period of time than would in the presence of water been at all necessary, nevertheless no perceptible chemical action occurred; the two remained totally uncombined.

It must not be overlooked that the results are partly due to anhydrous hydrochloric acid in the liquid state, and partly to the same acid in the gaseous state, under great pressure, the one class of effects not being eliminated from the other in the present experiments; it is probable that if the substances could have been submitted to the action of the liquid acid alone, the chemical effects would have been much smaller even than they were. For instance, the action upon potassium, sodium, and tin appeared to be due to the influence of the acid in the gaseous state, as no gas was perceptibly evolved by these metals in the liquid acid. In the cases of potassium and sodium (the latter in particular) it is perhaps possible, though highly improbable, that the whole of the metal had been corroded before the liquid acid touched it; but with tin this was certainly not the case, some metallic tin being left uncorroded at the end of the experiment.

Oxides in general, with the exception of lime and certain others which do not readily combine with aqueous hydrochloric acid, were slowly converted in a greater or less degree into chlorides. Carbonates also, except that of lime, were in general converted in a greater or less degree into chlorides.

Such carbonates as were decomposed evolved no visible bubbles of gas in the liquid acid; this may be explained on the supposition that they were previously completely decomposed by the gaseous acid during the process of generation (this, however, was not the case with carbonate of soda), or that the liberated carbonic acid was in the liquid state and was dissolved by the liquid hydrochloric acid. In my former paper it was shown that liquid carbonic and hydrochloric acids generated and condensed together did not form two separate strata of liquid.

Sulphides were in some cases converted into chlorides; in other cases not so; in nearly all cases a trace of whitish sublimate was produced in the gaseous acid. The chlorate and nitrate of potash were both decomposed.

## PHYSICAL SCIENCE.

### *Diffusion of Gases through India-rubber and Biscuit-ware, by G. F. ANSELL.*

IN the course of my experiments upon the subject of indicating the presence of fire-damp in coal mines, I have made a curious observation, which I desire to record, because I am just now too much occupied with other matter to continue that subject. I have found that gases diffuse through india-rubber somewhat slowly, and it is well known that they diffuse rapidly through biscuit-ware. I have found that if a glass cylinder be intercepted at its middle by a plate of biscuit-ware securely cemented in, and that then one end of the cylinder be covered with a thin sheet of india-rubber, and diffusion allowed to proceed through the india-rubber, the gas (coal-gas in a very marked degree) which has diffused through the india-rubber, remains between that substance and the biscuit-ware, exerting

considerable force, although the other end of the cylinder be perfectly open to the atmosphere.



India-rubber.

Biscuit-ware.

Open.

The reason of this is somewhat obscure, but I am inclined to think that it will be found in the existence of two forms of the same gas (mine gas, for example); one which will permeate india-rubber but not biscuit-ware, and *vice versa*. My other experiments take all my spare time, but so soon as they are finished—and they are now rapidly coming to a close—I shall investigate the facts above recorded.

Royal Mint, June 2.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, June 1.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., Vice-President, in the Chair.

THE minutes of the previous meeting were read and confirmed, and the donations to the Society's library, which included the Actonian Prize Essay of Mr. George Warrington, were duly acknowledged. Mr. George B. Robertson and Mr. Edward Swann were formally admitted Fellows of the Society, and Mr. William A. Tilden, of the Pharmaceutical Society's laboratory, was duly elected by ballot. The names of Mr. James Parkinson, Royal School of Mines, and Mr. Frederick Rowe, Colchester, were proposed for the first time.

Professor WILLIAMSON then invited the President, Dr. W. A. Miller, to favour the Society with his promised discourse upon "*Some Points in the Analysis of Potable Waters*," which he was glad to see admitted of experimental illustration.

Dr. MILLER prefaced his remarks by a brief statement, to the effect that it must not be supposed that the whole subject would be treated under a novel aspect; there were certain points of novelty involved in some of the methods which he proposed to bring forward, but at the same time he desired to discuss with his colleagues the old modes of analysis, many of which might be beyond criticism, whilst others appeared to the speaker open to serious objection. He referred particularly to the determination of the so-called "organic matter" in waters, and it was with the view of insuring greater uniformity in operating and in reporting the analytical results that he was anxious to introduce the subject for general discussion. In order to exhibit the principle of the permanganate method of determining oxidisable organic matter, Dr. Miller commenced with a comparative experiment upon "filtered Thames" and distilled waters, to equal portions of which were added a small quantity of mineral acid (sulphuric or hydrochloric), and measured portions of a standard solution of permanganate of potassium dropped in from a small graduated pipette; at the end of half an hour the first had become perfectly bleached, while the pure water had not in the least degree altered the pink colour of the permanganate. It was proposed to add successive doses of the reagent by ten or twenty grains measure at a time, until on standing fifteen minutes at the ordinary temperature the colour of the solution was no longer discharged. The results obtained by such a mode



of proceeding were truly comparative, if not in themselves absolute, expressions of the amount of organic matter dissolved in the water. Before commencing the analysis a physical examination of the sample of water might first be made, and for a judgment of the colour it was convenient to look through a stratum of two feet in length, as proposed by Dr. Letheby. [The long glass tubes fitted with flat plates at the lower extremity were exhibited.] Water examined in this way showed a yellow, green, or brownish tinge when compared side by side with pure distilled water, and with a white reflecting surface beneath. With regard to the taste of water, Dr. Clark pointed out many years ago the advantage of raising the temperature of the sample to  $80^{\circ}$  or  $85^{\circ}$  F., when differences of flavour not appreciable in the cold water became at once apparent. The odour might be noted under the same circumstances, particularly after addition of baryta to liberate the ammonia. For the estimation of the amount of sediment half a gallon of the water might be passed through a tared filter, dried, weighed, and afterwards incinerated for the purpose of deducing the proportions of organic and mineral matters originally held in suspension. The determination of "hardness" by Dr. Clark's soap-test gave a result of practical interest; the precautions had been so fully described, both by the inventor and by Mr. Dugald Campbell, that he had only a single recommendation to offer—viz., that it was necessary to boil the water for at least an hour before testing its hardness in comparison with that of the water in its natural condition. In conducting this operation of boiling, Dr. Miller made use of a long (three-feet) length of glass tubing, the lower extremity of which was cut off obliquely, and just above this point the tube was expanded into a bulb, which might be conveniently rested in the neck of an ordinary flask, and would be sure to fit close enough to prevent the escape of aqueous vapour during the ebullition, and the tube would serve to condense the whole of the steam.

*Determination of Organic Matter.*—Allusion having been made to the difficulty of insuring exact results by the incineration process, the lecturer proceeded to describe the conditions under which he usually operated. If a water contained much carbonate or chloride of magnesium, it was quite useless to evaporate it to dryness *per se*, for at the temperature at which the organic matter in the dry residue would be destroyed, much of the acid constituents of these magnesium compounds would also be driven off. To avoid errors from this source, it was advisable to add a known weight of perfectly dry carbonate of sodium—say, four or five grains of the alkaline salt to two deci-gallons of the water—before carrying the evaporation to dryness; then heat the dry residue to  $280^{\circ}$  F. (or not above  $300^{\circ}$  F.), weigh, and ignite to burn off the organic matter. This process should be conducted at the lowest visible heat, and a platinum capsule with tight-fitting lid could be employed with advantage. At this stage the saline residue would have lost an appreciable amount of carbonic acid, which should be restored by moistening the mass with an aqueous solution of that substance, again evaporating and drying the residue at  $280^{\circ}$  F., or better, at the identical temperature employed in the first instance. An exposure for one hour in the air bath was sufficient to drive off the water contained in the hydrated sulphate of lime, besides all traces of moisture. The difference between the weights before and after ignition was usually expressed as "organic matter," but the speaker was not satisfied with this definition, nor did he place much reliance upon the indications afforded by this method of operating. Referring to the experiment on the table, Dr. Miller entered into a full description of the permanganate test, and stated that it was due to Forchhammer, who proposed its adoption fourteen or fifteen years ago. The quantity of water usually taken for this purpose was eight fluid ounces, or one twentieth part of a gallon, to which was added thirty drops of concentrated hydrochloric acid (or a smaller amount of sul-

phuric acid), and by degrees the permanganate solution as already explained. The latter was prepared by dissolving 3.95 gr. of the pure crystallised permanganate of potassium in 10,000 gr. of pure water, and the solution was consequently equivalent to  $\frac{1}{10000}$ th of its weight of oxygen. To make sure of the correctness of the standard, the permanganate was checked by a freshly prepared solution of 7.875 grains of crystallised oxalic acid in 10,000 grs. of water. Incidentally, it was mentioned that oxalic acid in aqueous solution gradually underwent a change, and slowly absorbed atmospheric oxygen. The mode of employing the permanganate having been demonstrated, Dr. Miller further remarked that different experiments made upon the same water gave sufficiently concordant results; and although this chemical reagent did not enable the analyst to discriminate between the different kinds of organic matter, it would be found, as a rule, that the bodies most dangerous and objectionable in water were at the same time those which were most readily destroyed. The amount of organic matter by weight could not, therefore, be inferred from the known volume of permanganate required to effect its destruction; but the results were indicative of the amount of oxidisable substances in solution, and the quality of the water could be judged from a number of comparative trials. It had been objected that nitrites and possibly other reducing agents affected this test; but he found no difficulty in distinguishing between nitrites and organic matter, inasmuch as the lower oxides of nitrogen instantly reduced the permanganate and organic matter only after an interval of time, so that it was easy to go on adding the pink solution until the colour became permanent, and then afterwards observe the action due to organic matter alone. The test for nitrites proposed by Dr. D. S. Price was very delicate; its action was shown by mixing a few drops of iodide of potassium with dilute sulphuric acid and a little starch, and then on adding the water a blue colour was immediately developed in the event of nitrites being present. Nitric acid was frequently present in waters, and could be readily estimated by Dr. Pugh's excellent method, which was based upon the conversion of an acid solution of protochloride of tin into bichloride at the expense of the oxygen in the nitrate. The pressure tubes should be only three-fourths filled with the liquid, and merely heated for a short time to  $340^{\circ}$  Fahr. in an air bath; being then opened, the contents were washed out and tested by a standard solution of bichromate of potassium, for the purpose of ascertaining the amount of protochloride of tin yet remaining. The employment of Mohr's burette with Erdmann's float left nothing to be desired on the score of volumetric accuracy, and the bichromate was allowed to flow in until a mixture of iodide of potassium and starch previously added to the stannic solution became blue.

The conclusion of Dr. Miller's discourse and the discussion which followed are unavoidably postponed until next week.

The meeting was adjourned until Thursday, June 15, when Dr. Frankland and Mr. Duppa will give an account of their researches "*On the Transformation of Lactic into the Acrylic Series of Acids.*"

## ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 19.

*On the Physical and Chemical Constitution of the Fixed Stars and Nebulae.*

By WILLIAM HUGGINS, Esq., F.R.A.S.

THE speaker commenced with a few preliminary remarks on the peculiar relation in which the heavenly bodies stand to man. It is alone from these lights shining upon us from distant space that we can obtain any knowledge of the parts of the universe which are without the earth. The experimentalist who seeks to bring to light the truths which lie hidden beneath terrestrial phenomena, can



subject the object of his research to each other's influence and to the various forms of force; but the astronomer is left to the indications afforded by the sense of sight alone, for the interpretation of the heavens. The distances, magnitudes, and relative motions of the sun, moon, and planets have been obtained with great exactness, but in an important respect our knowledge of the heavenly bodies was at fault. Until quite recently we possessed no knowledge from observation of the structure and chemical constitution of the sun, the fixed stars, and the nebulae. Fortunately, for the increase of our knowledge, the cause of failure lay not in that the light of these bodies is wanting in sufficient indications of their nature, but in that the unaided eye has no power to perceive the indications by which the light of each of the heavenly bodies is specially distinguished.

Newton opened the way to a knowledge of these unperceived qualities of light. He was the first to show that by the refractive power of a prism of glass the component rays of a beam of light could be separated and presented to the eye as a band of blending colours. Wollaston and Fraunhofer discovered that the colours of the spectrum of solar light are not continuous, but are interrupted by transverse linear spaces where the light is wanting. In these lines of darkness of the solar and stellar spectra, the chemical nature of the sun and stars stands written in cypher, but for half a century the lines of Fraunhofer remained uninterpreted.

In 1859 Kirchhoff announced the law by which these dark lines can be deciphered. He immediately applied his method of interpretation to the light of the sun, and discovered in that body the presence of several of the elementary forms of matter which enter into the composition of the earth.

The speaker stated that it was his intention on this occasion to bring before the members of the Institution the results of the extension of this method of analysis by the prism to the heavenly bodies other than the sun. These researches have been carried on in his observatory during the last three years; and in respect of the greater part of these observations—viz., those on the moon, the planets, and the fixed stars, he has had the great pleasure of working conjointly with his distinguished friend, Professor W. A. Miller.

The speaker then referred briefly to the principles of spectrum analysis, upon which their interpretation of the phenomena observed in the spectra of the heavenly bodies was based, stating that spectra may be arranged under three orders—viz. :—

1. A continuous spectrum unbroken by bright or dark lines, which indicates that the light has not undergone any modification on its way to us. Also that its source is an opaque body, almost certainly in the solid or liquid state. Such a spectrum gives no information of the chemical nature of the substance from which the light emanates.

2. A spectrum of bright lines separated by dark spaces; this informs us that the source of the light is matter in the gaseous state. By a comparison of the bright lines of such a spectrum with the lines of terrestrial flames we may discover whether any of these terrestrial substances exist in the distant and unknown source of light. The spectra of many of the nebulae are of this order.

3. A continuous spectrum interrupted by dark lines; this shows that the light has passed through vapours which have deprived it of certain refrangibilities by a power of selective absorption.

Since Kirchhoff has shown that these dark lines agree exactly in position with the bright lines which the vapours would emit if in a luminous state, a comparison of these dark lines with the bright lines of terrestrial vapours will indicate whether any of these are present in the vapours through which the light has passed. The spectra of the fixed stars are of this order. In the case of these bodies,

the vapours that produce the dark lines immediately surround them, and are those of the substances of their surfaces. The chemical constitution of the stellar atmospheres will correspond, at least in part, with that of the stars themselves.

The speaker then described the special form of apparatus by which he and Professor Miller have compared the spectra of the stars by a method of simultaneous observation, with the spectra of many of the terrestrial elements.\*

This apparatus is adapted to the eye-end of an achromatic telescope of eight inches aperture. The telescope is mounted equatorially, and follows the star to which it is directed by means of an accurately adjusted clock-motion.

The point of light which a star forms in the focus of the object-glass is lengthened in one direction only by a cylindrical lens. The short line of light falls upon a narrow slit, and the diverging rays are rendered parallel by an achromatic lens. They are then refracted by two prisms of dense flint glass of 60°. The spectrum is viewed with a small achromatic telescope which is carried by a micrometer screw. By means of this the observer can measure with great precision the position of the stellar lines relatively to those of the solar spectrum.

The spectra for comparison were obtained from the spark of an induction coil taken between electrodes of various metals. Sometimes a wire of platinum surrounded with cotton and moistened with a solution of the substance required was employed. The light from the spark is reflected by a small moveable mirror upon a reflecting prism covering one-half of the slit. By this arrangement the spectrum of the star and the spectrum of the metal compared with it are seen in juxtaposition, and the coincidence or the relative position of a dark line in the stellar spectrum with a bright line in the metallic spectrum can be determined with very great precision. These comparisons are observations of great delicacy, and can be satisfactorily made on the finest nights only.

#### *Results of the Observations on the Moon and Planets.*

*Moon.*—Limited portions of the moon's surface were examined under varied conditions of illumination. As yet no strongly marked modification of the solar light has been detected, which would indicate a lunar atmosphere of considerable extent. The mode of disappearance of the spectrum of a star, when occulted by the moon, is negative as to the existence of an atmosphere about the moon.

*Jupiter.*—Several lines in the spectrum of Jupiter indicate a powerful absorption by the atmosphere of this planet. These were compared with the lines of our atmosphere. The atmosphere of this planet contains some of the gases or vapours present in our atmosphere, but it is not identical with it in constitution.

*Saturn.*—The observations of this planet are less certain because of the feebleness of its light. Some of the lines produced by its atmosphere appear to be identical with those seen in the spectrum of Jupiter.

*Mars.*—The lines characterising the atmospheres of Jupiter and Saturn are not present in the spectrum of Mars. Groups of lines appear in the blue portion of the spectrum, and these by causing the predominance of the red rays, may be the cause of the red colour which distinguishes the light of this planet.

*Venus.*—All the stronger lines of the solar spectrum were seen in the brilliant light of Venus, but no additional lines indicating an absorptive action of the planet's atmosphere.

In the case of most of the planets the solar light is probably reflected not from the planetary surface, but from

\* It is upon this method of direct comparison that the trustworthiness of the results which they have obtained chiefly depends. In this respect, too, their observations stand alone. In 1815 Fraunhofer recognised several of the solar lines in the spectra of the Moon, Venus, Mars, and four of the fixed stars. In 1862 Donati published diagrams of three or four lines in fifteen stars. Recently Secchi, Rutherford, and the Astronomer Royal have given diagrams of the positions, obtained by measurement only, of a few strong lines in several stars.



clouds at some elevation above it; under such circumstances the light would not be subjected to the absorbent action of the lower and denser portions of the planet's atmosphere, which are precisely those of our atmosphere, which are most effectual in producing the so-called atmospheric lines.

*Results of the Observations on the Fixed Stars.*

Since these bodies are self-luminous, we may hope to gain by prismatic analysis more information of their nature, than it is possible to do of the planets which all shine by reflecting the sun's light.

What are the stars? Endeavour with the most powerful telescopes to approach them, still they assume no apparent size; they remain under the highest magnifying powers what they appear to the unaided eye, diskless, brilliant points.

Until quite recently, our knowledge of the stars might be summed up thus:—That they shine; that they are immensely distant; that the motions of some of them show them to be composed of matter endowed with a power of mutual attraction.

Photographs of drawings of the spectra of several stars were projected on a screen by means of the electric lamp. In these were seen the coincidences and relative positions of the dark lines of the stars with the bright lines of the elements which had been compared with them.

The results on the light of the stars Aldebaran and  $\alpha$  Orionis (Betelgeux) are given in the following table:—

*Elements Compared with Aldebaran.*

Coincident.

1. Hydrogen with lines C and F
2. Sodium „ double line D
3. Magnesium „ triple line *b*
4. Calcium „ four lines
5. Iron „ four lines and E
6. Bismuth „ four lines
7. Tellurium „ four lines
8. Antimony „ three lines
9. Mercury „ four lines

Not coincident.

Nitrogen	three lines
Cobalt	two lines
Tin	five lines
Lead	two lines
Cadmium	three lines
Barium	two lines
Lithium	one line

70 lines measured.

*Elements Compared with  $\alpha$  Orionis (Betelgeux).*

Coincident.

1. Sodium with double line D
2. Magnesium „ triple line *b*
3. Calcium „ four lines
4. Iron „ three lines and E
5. Bismuth „ four lines
6. Thallium?

Not coincident.

Hydrogen	C and F
Nitrogen	three lines
Tin	five lines
Lead	two lines
Gold?	
Cadmium	three lines
Silver	two lines
Mercury	four lines
Barium	two lines
Lithium	one line

80 lines measured.

The 70 or 80 lines measured represent some of the stronger only of the numerous lines which are seen in the

spectra of these stars. Some of these are probably due to the vapours of other terrestrial elements which have not been compared with these stars. It would be assumption to suppose that the sixty-five so-called elements constitute in its entirety the primary material of the universe. Doubtless in the spectra of the stars the chemist is introduced to many new elements—would that it were possible for him to recognise and to isolate them!

It is a very suggestive fact that the lines of hydrogen corresponding with C and F of the solar spectrum are wanting in the spectra of  $\alpha$  Orionis and  $\beta$  Pegasi, and in these two stars only, out of more than fifty stars examined,  $\beta$  Pegasi contains sodium, magnesium, perhaps barium.

Sirius „ sodium, magnesium, iron, hydrogen.

$\alpha$  Lyrae (Vega) sodium, magnesium, iron.

Pollux „ sodium, magnesium, iron.†

No stars sufficiently bright to give a spectrum have been observed to be without lines. Star differs from star alone in the grouping and arrangement of the numerous fine lines by which their spectra are crossed.

The dark lines of absorption are strongest in the spectra of stars the light of which is tinted with yellow or red. In white stars the lines, though equally numerous, are very fine and faint, with the exception of the lines of hydrogen which are relatively very strong. This suggests a peculiar condition of the investing atmospheres of white stars; a modification depending possibly upon their high temperature.

A comparison of the spectra of stars which differ in the colour of their light suggested the opinion that the colours of the stars have their origin in the chemical constitution of their atmospheres.

Since the source of the light of the stars is intensely heated solid (possibly liquid) matter, the light at the time of emission would be white alike in all the stars.

The colours of the spectrum in which the lines of absorption are most closely grouped would be subdued in power relatively to the other colours, which would then predominate in the light of the star. This opinion is supported by the different arrangements of the lines in the spectra of the orange and blue components of the double star  $\beta$  Cygni.

From the additional knowledge which these spectrum observations give us, we are entitled to conclude that in plan of structure the stars closely resemble the sun. The source of their light is probably solid matter,‡ in a highly incandescent state. Around this photosphere, there exists an atmosphere of vapours of such of the elements of the stars as are volatile at their high temperature.

A community of matter appears to exist throughout the visible universe, for the stars contain many of the elements which exist in the sun and earth.

It is remarkable that the elements most widely diffused through the host of stars are some of those most closely connected with the living organisms of our globe, including hydrogen, sodium, magnesium, and iron. May it not be that, at least, the brighter stars are like our sun, the upholding and energising centres of systems of worlds, adapted to be the abode of living beings?

*Results of the Observations on the Nebulae.*

Besides the stars, the heavens are mottled over with feebly shining cloudlike patches and spots, often presenting strange and fantastic forms. Between 5000 and 6000

† The spectra of the following stars have also been examined:—Castor;  $\epsilon$ ,  $\zeta$ , and  $\eta$  Ursæ Majoris;  $\alpha$  and  $\epsilon$  Pegasi;  $\alpha$ ,  $\beta$ ,  $\gamma$  Andromedæ; Rigel,  $\eta$  Orionis;  $\alpha$  Trianguli;  $\gamma$  and  $\epsilon$  Cygni;  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\epsilon$ , and  $\eta$  Cassiopeiæ;  $\gamma$  Geminorum;  $\beta$  Canis Minoris;  $\beta$  Canis Majoris; Spica,  $\gamma$ ,  $\delta$ , and  $\epsilon$  Virginis;  $\alpha$  Aquilæ; Cor Caroli;  $\beta$  Aurigæ; Regulus,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ ,  $\zeta$ , and  $\eta$  Leonis.

‡ The phenomenon of the solar spots appears to show that the solid matter of the sun's photosphere exists in a finely-divided state, and may be compared to the carbon in an ordinary gas-flame, or to the cloud of phosphoric acid when phosphorus is burnt in oxygen. The sun's surface consists of this matter separated into masses, which are neither uniform in size nor regular in form; they may be compared to clouds.



of these so-called nebulae are known. What is the nature of these strange objects? Dense swarms of suns melted into one mass by their enormous distance? Chaotic masses of the primordial material of the universe? The telescope alone would fail to give answers to these questions, and the analysis by the prism of objects so feebly luminous appeared hopeless.

In August last the speaker directed his telescope, armed with the spectrum apparatus, to a small but comparatively bright nebula, 37 H. iv. His surprise was great to observe that in place of a band of coloured light, such as the spectrum of a star would appear, the light of this object remained concentrated in three bright bluish-green lines, separated by dark intervals. This order of spectrum showed the source of the light was luminous gas. The brightest of the three lines has a position in the spectrum about midway between *b* and *F*. More refrangible than this line, and separated from it by a dark interval, a fainter line occurs. The third and faintest line coincides with *F*, and with a line of hydrogen. The brightest line agrees in position with the brightest of the lines of nitrogen. The line intermediate in refrangibility does not correspond with any of the elements compared with it.

#### NEBULÆ,

<i>The Spectrum which indicates Gaseity.</i>		<i>The Spectrum of which is Continuous.</i>
37 H. iv.	Three bright lines.	92 M.
6 $\Sigma$		50 H. iv.
73 H. iv.		31 M.
51 H. iv.		32 M.
1 H. iv.		55 Andromeda.
The great Neb. in Orion.	A fourth faint line also.	26 H. iv.
18 H. iv.		15 M.
		2 M.
Annular Neb. in Lyra	The brightest line only.	
Dumb-bell Neb.		

A careful examination of different portions of the Dumb-bell nebula, and of the great nebula in Orion, showed that both these nebulae are uniform in constitution throughout; the light from one part differs from that of another in intensity alone.

The nebulae 37 H. iv. and 73 H. iv., in addition to the bright lines, give a faint continuous spectrum: this was proved to be due to the light of the nucleus.

These observations appear to authorise the following opinions of the nature and structure of those of the nebulae which gave a spectrum of bright lines.

1. The light from these nebulae emanates from intensely heated matter existing in the state of gas. This conclusion is corroborated by the great feebleness which distinguishes the light from the nebulae. A circular portion of the sun's disk subtending 1' would give a light equal to 780 full moons, yet many of the nebulae, though they subtend a much larger angle, are invisible to the naked eye. §§ Upon the earth, luminous gas emits a light which is very inferior in splendour to incandescent solid matter.

2. If these enormous masses of gas are luminous throughout, the light from the portions of gas beyond the surface visible to us would be in a great measure extinguished by the absorption of the gas through which it would have to pass. These gaseous nebulae would, therefore, present to us little more than a luminous surface. This consideration may assist in explaining the strange apparent forms of some of the nebulae.

3. It is probable that two of the constituents of these nebulae are the elements, hydrogen and nitrogen, unless the absence of the other lines of the spectrum of nitrogen

indicates a form of matter more elementary than nitrogen. The third gaseous substance is at present unrecognised.

4. The uniformity and extreme simplicity of the spectra of all these nebulae oppose the opinion that this gaseous matter represents the "nebulous fluid" suggested by Sir William Herschel, out of which stars are elaborated by a process of subsidence and condensation. In such a primordial fluid all the elements entering into the composition of the stars should be found. If these existed in these nebulae, the spectra of their light would be as crowded with bright lines as the stellar spectra are with dark lines.

The supposition can scarcely be entertained that the three bright lines indicate a more primary and simple condition of matter; for then, if the process of elaboration into stars be now taking place, we should expect to find in some of the nebulae, or in some parts of them, a more advanced state towards the formation of the separate elements of which we now know the stars to consist. Such an advance would be indicated by an increased number of bright lines. It is difficult to suppose that the excessively high temperature of the nebulae keeps in check affinities by which, if unrestrained, the formation of the elements would take place; for in some of the nebulae a nucleus exists, which from its continuous spectrum, its greater brightness, and apparent separation from the surrounding gas, we must regard as containing solid or liquid matter. At a temperature at which matter can become liquid or solid (though from peculiar conditions that temperature may be a very exalted one) we cannot suppose the formation of the chemical elements to be restrained by excessive heat.

5. A progressive formation of some character is suggested by the presence of more condensed portions, and in some nebulae, of a nucleus. Nebulae, which give a continuous spectrum, and yet show but little indication of resolvability, such as the great nebula in Andromeda, are not necessarily clusters of stars. They may be gaseous nebulae, which by the loss of heat or the influence of other forces have become crowded with portions of matter in a more condensed and opaque condition.

6. If the observations of Lord Rosse, Professor Bond, and others are accepted in favour of the partial resolution of the annular nebula in Lyra, and the great nebula in Orion into discrete bright points, these nebulae must be regarded not as simple masses of gas, but as systems formed by the aggregation of gaseous masses. Is it possible that the permanence of general form of these nebulae may be maintained by the motions of these separate masses?

7. The opinion of the enormous distance of the nebulae from our system, since it has been founded upon the supposed extent of remoteness at which stars of considerable brightness would cease to be separately visible in our telescopes, has no longer any foundation on which to rest in reference at least to those of the nebulae which give a spectrum of bright lines. It may be that some of these are not more distant from us than the brighter stars.

8. As far as the speaker's observations extend, they appear to be in favour of the opinion that these nebulae are gaseous systems possessing a structure and a purpose in relation to the universe altogether distinct from the great cosmical masses to which the sun and the fixed stars belong. What is this special purpose? Many fascinating theories present themselves in connection with the great problems of the conservation of the energy of the universe, and of the source and maintenance of solar and stellar heat. In the opinion of the speaker, science will be more advanced by the slow and laborious accumulation of facts than by the easier feat of throwing off brilliant speculations.

#### ACADEMY OF SCIENCES.

May 29, 1865.

M. PASTEUR presented a note "On the Deposits which Form

§§ See "Outlines of Astronomy," by Sir John F. W. Herschel, p. 616. Seventh Edition.



in Wines," of which he recognises three kinds. The first is a deposit of crystalline bitartrate of potash or tartrate of lime, or a mixture of the two. The second, which adheres to the sides of the bottles, is oxidised colouring matters. These two are deposited in sound wines, but the third, which falls in sick wines, consists of cryptogamic vegetation. The author believes that wines are greatly improved by the influence of oxygen, and recommends that they should be left in casks, and bottled as they are wanted. He is speaking, it must be remembered, of French wines.

M. Kuhlmann presented the fifth part of his memoir "On the Crystallogenic Force." In this part he says that he ought to speak of the crystallisation of supersaturated solutions, but that part of the subject he passes over for the present, expressing an opinion, however, opposed to MM. Viollette and Gernez, that the intervention of a small quantity of the same saline matter is indispensable for such crystallisations. There are one or two matters of practical interest in the paper to which we shall return, and now only quote a few remarkable examples of the crystallisation of metals and metalloids. A solution of sulphide of arsenic in ammonia after some months deposits arsenic in a crystalline state, and with a metallic lustre. Part of the metalloids become oxidised, and sulphate or arseniate of ammonia is formed. A crystal of sulphate of copper placed in a solution of polysulphide of potassium soon becomes covered with sulphide of copper, on which rhombohedral crystals of sulphur deposit. Crystals of calomel placed in a solution of monosulphide of potassium get converted into crystallised cinnabar. Gold may be obtained in beautiful crystalline spangles by placing a solution of the chloride contained in a porous vessel in a solution of ferrous sulphate, hyposulphite of soda, or oxalic acid. Large crystals of sulphate of copper placed in a solution of monosulphide of potassium, he found to become coated with sulphide of copper, underneath which he found crystals of metallic copper, with sulphate of copper in their interiors, and around them a double salt of copper and potassium.

Another part of the memoir of M. Persoz, "On the Molecular State of Bodies," was read. The part relates to boiling points of liquids, which he considers to depend on their molecular volumes.

M. Lallemand presented a note "On Ammoniacal Cyanide of Copper," in reply to MM. Schiff and Becchi (see ante, p. 21). The results obtained by these three chemists do not agree, and M. Lallemand naturally thinks that they experimented upon different compounds, none of which, as the matter now stands, are of much interest.

M. Cahours communicated some "Researches on the Sulphuretted Radicals." The author points out that sulphur has a strong tendency to form with radicals of different alcoholic series, compounds of the type



corresponding to sulphurous acid or the hypothetical compound  $S_2H_4$ , in which three of the equivalents of hydrogen will be replaced by alcohol radicals, while the fourth will be substituted by a metalloid radical. He remarks also that while sulphur and oxygen present manifest analogies in their chemical functions; there are, nevertheless, cases in which we notice in their molecular properties differences which it is impossible to explain. Sulphydric acid and aqueous vapour present, under numerous circumstances, the strictest analogies. Various alcohols and ethers are derived from the second, just as mercaptans and sulphydric ethers are obtained from the first. But if we compare the boiling points of the different products derived from sulphydric acid, we notice that as one or two molecules of hydrogen are replaced by an alcohol radical, the boiling point rises with the complexity of the molecule of hydrocarbon substituted, while in the case of products derived from water, the boiling point is lower than that of water

until the compound  $C_8H_9$  is introduced. The author gives a table illustrating this, from which we quote one or two instances:—

$\begin{matrix} H \\ H \end{matrix} \left. \begin{matrix} O_2 = 4 \text{ vols. boils at} \\ 100^\circ. \end{matrix} \right\}$	$\begin{matrix} H \\ H \end{matrix} \left. \begin{matrix} S_2 = 4 \text{ vols. boils at} \\ -73^\circ. \end{matrix} \right\}$
$\begin{matrix} C_2H_5 \\ C_2H_3 \end{matrix} \left. \begin{matrix} O_2 = 4 \text{ vols. boils at} \\ -18^\circ. \end{matrix} \right\}$	$\begin{matrix} C_2H_5 \\ C_2H_3 \end{matrix} \left. \begin{matrix} S_2 = 4 \text{ vols. boils at} \\ +41^\circ. \end{matrix} \right\}$
Methyle ether.	Sulphydromethyle ether.
$\begin{matrix} C_6H_7 \\ C_6H_7 \end{matrix} \left. \begin{matrix} O_2 = 4 \text{ vols. boils at} \\ +70^\circ. \end{matrix} \right\}$	$\begin{matrix} C_6H_7 \\ C_6H_7 \end{matrix} \left. \begin{matrix} S_2 = 4 \text{ vols. boils at} \\ \text{a much higher temp.} \end{matrix} \right\}$
Propyle ether.	Sulphydropropyle ether.

## NOTICES OF BOOKS.

*Poggendorff's Annalen der Physik und Chemie.* No. 4. 1865.

THE number opens with an article by C. Rammelsborg, "On the Composition of Manganese Ores, and their Specific Gravity." The author has investigated principally the composition of the natural oxides of manganese, and his results with the more common minerals are as follows:—

1. *Pyrochroite*.—Hydrated manganous oxide,  $MnO + aq.$
2. *Braunite*.—Manganic oxide,  $Mn_2O_3$ , sometimes with silicate and sometimes with a certain amount of iron in place of manganese.
3. *Manganite*.—Hydrated manganic oxide,  $Mn_2O_3 + aq.$
4. *Hausmannite*.— $Mn_3O_4$ , or  $MnO + Mn_2O_3$ .
5. *Pyrolusite*.—Peroxide of manganese,  $MnO_2$ .

The author discusses the constitution of the higher oxides, and seems to regard them as compounds of manganous oxide with peroxide.

In a paper on "Forests and Weather" Dr. Berger relates a number of thermometrical observations made to determine the influence of wooded spaces on temperature, &c.

An article "On Meteorites," by C. Buchner, gives an account of various specimens in well-known collections and museums.

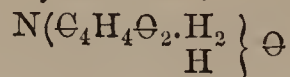
The remaining papers which have not appeared in the CHEMICAL NEWS are by R. Thalen, "On the Determination of the Limits of Elasticity in Metals," by J. Stefan, "An Experiment on the Nature of Unpolarised Light, and the Double Refraction of Quartz," and by J. Müller "On the Wave Length of the Blue Indium Line," which the author has determined to be 0.000455 min.

*Annalen der Chemie und Pharmacie.* May. 1865.

THERE is but little to notice in this number. The first paper is by Heintz, "On the Extraction of Cæsium and Rubidium Compounds in a Chemically Pure Condition." The process is applicable to extraction of the rarer alkalis from the mother liquor of the Nauheim springs. The author finds that a boiling dilute solution of chloride of platinum added to a boiling solution (rather dilute) containing potassium, rubidium, and cæsium will precipitate the latter metals with but a very small proportion of the first. The platinum being removed from this precipitate, the alkaline metals are again brought into dilute solution as chlorides; the solution is heated to boiling, and once more a dilute solution of chloride of platinum is added in two portions. After each addition the liquor is filtered, while boiling, through a water-bath filter, and the precipitate is washed with hot water; the solution is then allowed to cool and deposit. In this way three precipitates are obtained; the first contains nearly all the cæsium, the second almost all the rubidium, and the third, deposited on cooling, is for the most part the potassium compound. By repeating these precipitations the compounds may be almost completely separated. In the end the author recommends that the chlorides should be converted into tartrates, and further purified by Bunsen's process.



The next article is by Teuchert, "On Succinaminic Acid"



obtained by the action of caustic baryta on succinimide, and some salts of that acid.

A paper which physiological chemists will read with much interest is Dr. Eichwald, "On Mucin," a contribution to the chemistry of tissue-formed substances. The remaining papers call for no notice.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1174. W. H. Smith, Haverstock Hill, Middlesex, "Improvements in photographing upon wood, and in the preparation of wood, canvas, silk, glass, and other substances for the purpose of receiving and retaining impressions."—Petition recorded April 26, 1865.

1336. G. H. Ogston, Mincing Lane, London, "Improvements in the manufacture and reburning or revivification of animal charcoal."—May 13, 1865.

1373. R. A. Brooman, Fleet Street, "An improved method of securing corks or stoppers in bottles."—A communication from G. Bonsignes, Reims, France.—May 18, 1865.

1385. T. Richardson, Newcastle-upon-Tyne, and M. D. Rücker, Leadenhall Street, "Improvements in obtaining certain compounds of nitrogen and of sulphur."

1386. W. Davey, Hackney Wick, Middlesex, "Improvements in apparatus for washing or purifying coal gas, and for producing ammoniacal water therefrom."—May 19, 1865.

1393. J. A. Coffey, Gracechurch Street, London, "Improvements in distilling apparatus."—May 20, 1865.

1405. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "An improved apparatus for freezing, iceing, and cooling liquids."—A communication from H. N. Ballemagre, Paris.

1409. R. Müller, Weiden, Bavaria, A. T. Weld, Gravesend, and J. F. Powell, Hyde Park, Middlesex, "Improvements in the preparation of materials for animal charcoal."—May 22, 1865.

1412. H. Wilde, Manchester, "Improvements in the production and application of electricity."

1413. I. Holt, W. Holt, J. Holt, and J. Maude, Bolton, Lancashire, "Improvements in dyeing and sizing cotton, silk, woollen, and other yarns."—May 23, 1865.

1420. J. Dale and A. Paraf, Manchester, "Improvements in calico and linen printing."—May 24, 1865.

#### NOTICES TO PROCEED.

194. E. Atkinson, Old Bond Street, Westminster, "An improved apparatus for containing and dispersing scents and other liquids."—Petition recorded Jan. 23, 1865.

226. A. A. Croll, Coleman Street, London, "Improvements in the purification of coal gas."—Jan. 26, 1865.

249. V. Burg, Paris, "Improvements in filtering apparatus."

250. W. E. Newbon, Chancery Lane, "Improvements in the rectification of alcohol, and in the apparatus to be employed therein."—A communication from A. A. Foubert, Rue St. Sebastien, Paris.—Jan. 28, 1865.

413. G. Harton, Kentish Town, Middlesex, "Improvements in waterproofing skins, hides, and leather."—Feb. 14, 1865.

796. W. M. Williams, Caergwrle, near Wrexham, Denbighshire, "Improvements in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydrocarbons, or for the manufacture of the said hydrocarbons and coke."—March 22, 1865.

1102. F. A. Abel, Woolwich, Kent, "Improvements in the preparation and treatment of gun-cotton."—April 20, 1865.

1220. A. H. Emerson and R. Fowler, Mildmay Park, Stoke Newington, "Improvements in the manufacture and application of glass and other vitreous compositions."—May 1, 1865.

1263. S. Bennett, East Lee, Kent, "Improvements in brewing, distillation, the production of vinegar, and the extract of malt and other grain."—May 5, 1865.

## CORRESPONDENCE.

### Continental Science.

PARIS, June 5.

A CURIOUS paragraph appears in the Vienna weekly medical journal. It is to the effect that the foreign physicians who have gone to St. Petersburg to study the Russian epidemic can get no information whatever on the subject. They are said to have been extremely well received and to be *fêted*, but everything relating to the disease is studiously concealed from them. They can't get at patients to watch the symptoms, and they can't get into a deadhouse to see a post-mortem. How far this is true remains to be seen, but appearing in the journal I have named, it bears the stamp of some authority.

The *mètre* is in danger. There is on the Continent an International Geodesic Association, originally founded, it is said, to extend the knowledge of and to develop the metrical system of France. The German astronomers, however, who have measured the arc of the circle which separates Leipsic from Berlin, have convinced themselves of the inaccuracy of the *mètre*, and wish to adopt the *toise* as the unit of length. Their reasons for this choice are not given in the paper from which I quote, and I have not had the opportunity of seeing the report of the secretary of the Association, Herr Forster, Director of the Berlin Observatory. Doubtless the Association can show good reasons, although for ordinary and practical purposes the *toise* would seem too long for an unit. At all events, this movement on the part of the Germans should make English people hesitate before they adopt a system which a few years may see abandoned for scientific purposes.

I read in *Cosmos* that some curious chemist has analysed some of the paper of books printed in the sixteenth century, and found copper and even gold in it. The Imperial Academy of Vienna has been discussing the question of the source of these metals, and the most general opinion appears to be that the rags from which the paper was made had, as was common in those days, metallic threads in the web.

Captain Coste, of the *Sarthe*, has sent home an interesting account of a curious phenomenon he observed about 9 p.m. on the 15th of last September. He was in longitude 50° E., and latitude 9° N., and saw the whole surface of the water white, as though covered with a cloth. On examining some of the water he found that the cause of this appearance was the presence of an innumerable quantity of animacules, which emitted a soft white phosphorescent light. The curious part of the story is, that these animacules only shine while the water is still; when it is agitated the light is extinguished. The same phenomenon has been observed before, but it is very rare. On this subject M. Babinet remarked that it is an error always to refer the phosphorescence of the sea to the presence of infusoria, for the Dead Sea, which is quite destitute of these beings, often becomes phosphorescent.

As I mentioned the petition of the Industrial Society of Mulhouse, asking for a delay in carrying out the decree ordering the consumption of smoke until an effectual means of doing it had been discovered, I may tell you that M. Behic, the Minister of Public Works, has refused to grant the delay, and tells the manufacturers, almost in so



many words, to use the best means they can, and perfect their apparatus as fast as possible.

Obviously, in an organ performance, the man who blows the bellows is not an unimportant agent. Some thought of this kind seems to have struck the Mulhouse Society, who, after bestowing medals on the discoverers and manufacturers of aniline and the dyes, have bethought themselves that the part of M. Collas, the distiller of *benzine*, ought not to be overlooked; and although they do not give him a medal, they desire to place on record their belief that he has powerfully, though indirectly, contributed to the development of the industry; and thus the Society adds more celebrity to the name of Benzine Collas.

Some of your readers who will, no doubt, soon be starting for the sea-side may, perhaps, thank me for quoting from *Les Mondes* a method of preserving star-fish with their natural colours. Directly they are taken from the water they must be plunged in tolerably strong alcohol for a minute or two, and then dried quickly at a temperature something below  $212^{\circ}$ . I think I have read this somewhere before; but it may be new to some readers.

#### *Alterations in the Density of Minerals.*

To the Editor of the CHEMICAL NEWS.

SIR,—Dr. Phipson, in a letter published in the CHEMICAL NEWS of November 19, 1864, promised to explain why I failed to corroborate his extraordinary statement as to changes in the density of certain minerals. Several months have now elapsed; my papers have been published; but the promised explanation has not, I believe, yet appeared. As I am about to make known the results of a third series of experiments on the subject, I should be glad if Dr. Phipson would furnish the long-expected answer, or, rather, refutation. I am, &c.

A. S. CHURCH.

Royal Agricultural College, Cirencester, June 5.

#### *The Mysterious Death at Dawlish.*

To the Editor of the CHEMICAL NEWS.

SIR,—Your recent numbers contain some communications on what has been called the "Mysterious Death at Dawlish," in which it has been stated that arsenic was the cause of death. The coroner has forwarded me the evidence of Dr. Baker, who was called in to the case, and from his evidence I find that on the 10th of April the body was found lying on its back, the head thrown backwards, the arms drawn up towards the head, and the fingers drawn forcibly towards the palms of the hands; after the post-mortem on the 26th he deposed that there was extreme rigidity of the whole body, the spine was completely curved, the head being drawn backwards, forming a concavity, the legs were extended, and the toes drawn to the sole of the foot, the muscles very rigid, the fingers drawn and unyielding, the brain and posterior part of the spinal cord congested, the pupils dilated, the bedclothes, too, were in a greatly rumpled and disordered state. I give Dr. Baker's own words, and his opinion was that the death was occasioned by strychnia, and most undoubtedly it was purely from strychnia, although arsenic was found in the stomach. This suicide is a most singular and interesting case, likely to have an important bearing on future murder cases, and therefore it is worth investigating. The woman had locked herself in the bedroom, and when entrance was effected through the window there was found on the floor three empty papers from rat poison, two of them had contained arsenic, and one of Battle's, which is very well known to be charged with strychnia.

I have seen perhaps twenty animals and reptiles killed with this poison, and found that whenever it was given in the powdered or crystalline state the tetanus commenced in fifteen minutes, and after a few horrible spasms the creatures died (say four or five minutes); if the poison was in a dissolved state the spasms were rarely

two minutes in arriving, so rapid was the absorption. Now if Mrs. Williams had mixed the three powders at once in the spoon found, and had drank the warm brandy and water to wash it down, wiping her lips with the handkerchief, all that followed would be accounted for—the strychnia would be in a more soluble state, would act very promptly, and destroy life before the more sluggish arsenic would irritate the stomach to vomiting and diarrhoea; that the death was extremely sudden is proved by this—there was an almond found between her teeth not masticated or even bitten.

This is the only case I know in which two poisons have been in the system at one time, but I think it likely that such will occur in future from the facility found of obtaining the so-called vermin powder.

I am, &c. WILLIAM HERAPATH, SEN.,  
Professor of Chemistry and Toxicology.

#### *Galibert's Respirator.*

To the Editor of the CHEMICAL NEWS.

SIR,—The invention described as Galibert's Respirator in the CHEMICAL NEWS of May 26, 1865, is so much like an apparatus invented by my father (illustrated and described by him in the *Mechanic and Chemist*, November 23rd, 1839), that nearly every reader will see that there is the same train of thought and reasoning for attaining the same end. Quite unbiassedly, I think my father's invention would obtain the preference, for he suggested that the air-bag should be filled with a mixture of one-thirtieth more oxygen than ordinary air.

The copper bag carried on the back is described by him as containing condensed air, which issues gradually and regularly into the hood. With this apparatus a diver, carrying weights round the waist, which he could release when he wanted to come up, would be enabled to explore for a quarter of an hour together the bottoms of canals, lakes, rivers, &c.

In thus writing I do so to claim for my father a priority of twenty-six years in this idea.

I am, &c.

CH. PIESSE.

Royal College of Chemistry, May 31.

### MISCELLANEOUS.

**Chemical Society.**—The next meeting of this Society will take place on Thursday next, at eight o'clock, when a paper, "On the Transformation of the Lactic into the Acrylic Series of Acids," will be read by Messrs. Frankland and Duppa.

**New Mode of Determining the Strength of Photographic Baths.**—Vogel recommends the use of a standard solution of iodide of potassium, which is to be added to the silver solution mixed with a little nitric and nitrous acids, and a few drops of solution of starch. The iodide is added until the blue colour is persistent after agitation.

### ANSWERS TO CORRESPONDENTS.

\*\* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. H.—Professor Smythe has not yet returned from Egypt.

C. F., *St. John's*.—Shall receive a private communication.

M. P. S.—We observed it. If our memory serves us, the same thing has been done before; but it is too contemptible to notice.

Dr. Phipson.—Received too late for insertion this week.

**Books Received.**—The "Dictionary of Chemistry," &c., by Henry Watts, B.A., Part xxxvii.; The "Phenomena of Radiation," &c., by G. Warrington, F.C.S.



# SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*An Introduction to Chemical Philosophy, according to the Modern Theories, by ADOLPHE WURTZ, F.R.S.*

## PART I.

### EQUIVALENTS, ATOMIC WEIGHTS AND MOLECULAR WEIGHTS.

#### SECTION II.—*New System of Atomic Weights.*

(Continued from page 266.)

According to Deville, sal ammoniac exists in the state of combination at  $350^{\circ}$ , because its elements if brought together at that temperature disengage heat. The argument may be put as follows:—

Is the disengagement of heat which is observed upon the mixture of two bodies always the effect and the proof of a change in the chemical constitution of their molecules, or of an addition or an exchange of atoms? These are important questions, the solution of which appears to have been given by the beautiful researches of M. Favre on the thermic effects of mixtures.\* Having added water to very weak sulphuric acid, M. Favre still observed a disengagement of heat. Thus the addition of four equivalents of water to sulphuric acid already diluted with fifty-six equivalents of water, still occasioned a slight increase in temperature. Who will be bold enough to affirm that the thermic effect is here due to a chemical combination giving birth to a new molecule? Can the molecule  $\text{SO}_3\cdot 6\text{HO}$  exist? If it can exist, can it assume the gaseous form? I believe not, and M. Favre considers justly that it is not affinity properly so called which comes into play in actions of the kind which he has observed. He has pointed out others which are similar. The addition of small quantities of water to concentrated solutions of certain salts, possessing their water of crystallisation, can give rise to a disengagement of heat; but if large quantities of water are added, a contrary effect takes place. The phenomenon of the diffusion of the salt in water occasions a diminution of heat.

But in the first place, the disengagement of heat is due, according to M. Favre, to a molecular attraction different from affinity. And why may not actions of this sort be observed in mixtures of gases? Why should not the molecules of hydrochloric acid and of ammonia, although they cannot combine at  $350^{\circ}$ —that is to say, unite and condense themselves into a true gaseous molecule—why should they not exercise a mutual action at this temperature? And why should not such an action give rise to a disengagement of heat, although it acts at a distance, not between the atoms in a single molecule, but between two different molecules? I am aware that we are dealing here with gases, and not with liquids. But it seems that the molecular constitution of gases does not exclude the idea of a reciprocal attraction able to exert itself at a distance between the atoms of two different molecules.

It may be imagined, on the other hand, that by the fact of their mixture, and by the effect of this attraction, which is perhaps only a degree of affinity, the molecules

of the two gases might acquire a stability which they would not possess when isolated. Here would be an explanation of that interesting fact observed by M. H. Deville, that the hydrocyanate of ammonia, or the mixture of hydrocyanic and ammoniacal gases, remains intact at temperatures in which these bodies are themselves decomposed.

It is far from my wish to pretend to have answered the questions I have just put. But is it not allowable to believe that the known facts authorise an interpretation different from that at which MM. Deville and Troost have arrived?

But let us admit for a moment that these questions may be answered in such a way as to oppose the generality of Ampère's law; let us admit that the molecular formulæ of certain bodies, formed, like sal ammoniac, by the union of two molecules, each of which forms 2 volumes of vapour, correspond to 4 volumes of vapour; or rather (for we can make this concession) let us admit that the molecules of such bodies would not take a gaseous form without their vapour expanding, thus forming two molecules which occupy 4 volumes, but which nevertheless remain united by a mutual attraction; these facts would not in any manner weaken the arguments which vapour densities have afforded us in favour of the new system of atomic weights. In fact, if it is possible that the molecule of certain complex bodies cannot take the gaseous form without forming 4 volumes of vapour, the known facts do not authorise us to admit that molecules of compound bodies can exist, which, in the gaseous state, would form less than 2 volumes of vapour;† and it would always be true to say that, for the immense majority of volatile compound bodies, the atomic weights are expressed by their double densities compared to hydrogen, as we have before shown.

We must now sum up this long explanation. After having investigated the origin of the doctrine of equivalents and of the atomic theory, we have followed their progress; we have shown that the notions of equivalent, atom, molecule, at first confounded with each other, have at length acquired distinct meanings; lastly we have demonstrated that of all the systems of atomic weights, that which we are seeking to establish agrees better with the data that are furnished by specific heat and isomorphism, and with the laws which govern the combinations of gaseous bodies.

But our task is not finished. Whatever may be the importance of these physical data in the subject under discussion, such an assistance would be unavailing if it were not strengthened by arguments drawn from the domain of pure chemistry. In a word, the new system of atomic weights must rely upon chemical proof. It is particularly necessary to know whether the double atomic weights, which we have adopted for most of the metals, harmonise with their chemical properties, and with the constitution of their combinations. We think that it is so, and we shall give, in the course of these pages, numerous arguments in support of this opinion.

For the present, we shall confine ourselves to remarking, in conclusion, that the new notation gives, for a very large number of bodies, formulæ identical with those which Berzelius‡ used for twenty years.

† Arsenious acid is alone an exception to this. Its vapour is twice too much condensed, like that of arsenic itself. The two anomalies are evidently connected together. Neither heat nor oxygen succeed in dividing the group of 4 atoms,  $\text{As}_4$  (page 158), which forms 2 volumes of free arsenic, and which enters into 2 volumes of arsenious acid,  $\text{As}_4\text{O}_6$ .

‡ Vide Cannizzaro "*Sunto di un corso di filosofia chimica*," page 48.



We will give some examples of them:—

	Formulae of Berzelius.	New Formulae.
Oxide of calcium . . .	$\text{CaO}$	$= \text{Ca}\ominus$
Chloride of calcium . . .	$\text{CaCl}_2$	$= \text{CaCl}_2$
Bromide of calcium . . .	$\text{CaBr}_2$	$= \text{CaBr}_2$
Iodide of calcium . . .	$\text{CaI}_2$	$= \text{CaI}_2$
Fluorine of calcium . . .	$\text{CaFl}_2$	$= \text{CaFl}_2$
Nitrate of lime . . .	$\text{N}_2\text{O}_5, \text{CaO}$	$= \text{N}_2\text{Ca}\ominus_6$
Hypochlorite of lime . . .	$\text{Cl}_2\text{O}, \text{CaO}$	$= \text{Cl}_2\text{Ca}\ominus_2$
Chlorate of lime . . .	$\text{Cl}_2\text{O}_5, \text{CaO}$	$= \text{Cl}_2\text{Ca}\ominus_6$
Sulphate of lime . . .	$\text{SO}_3, \text{CaO}$	$= \text{SCa}\ominus_4$
Sulphite of lime . . .	$\text{SO}_2, \text{CaO}$	$= \text{SCa}\ominus_3$
Carbonate of lime . . .	$\text{CO}_2, \text{CaO}$	$= \text{CCa}\ominus_3$
Acetate of lime . . .	$\text{C}_4\text{H}_6\text{O}_3, \text{CaO}$	$= \text{C}_4\text{H}_6\text{Ca}\ominus_4$
Valerate of lime . . .	$\text{C}_{10}\text{H}_{18}\text{O}_3, \text{CaO}$	$= \text{C}_{10}\text{H}_{18}\text{Ca}\ominus_4$
Benzoate of lime . . .	$\text{C}_{14}\text{H}_{10}\text{O}_3, \text{CaO}$	$= \text{C}_{14}\text{H}_{10}\text{Ca}\ominus_4$
Lactate of lime . . .	$\text{C}_6\text{H}_{10}\text{O}_5, \text{CaO}$	$= \text{C}_6\text{H}_{10}\text{Ca}\ominus_6$
Oxalate of lime . . .	$\text{C}_2\text{O}_3, \text{CaO}$	$= \text{C}_2\text{Ca}\ominus_4$
Tartrate of lime § . . .	$\text{C}_4\text{H}_4\text{O}_5, \text{CaO}$	$= \text{C}_4\text{H}_4\text{Ca}\ominus_6$

It is evident that we shall observe the same coincidence in the formula of the numerous compounds that correspond to the preceding, and which contain, instead of calcium, other diatomic metals. Concerning other compounds we will also quote the following formulæ:—

	Formulae of Berzelius.	New Formulae.
Water . . . . .	$\text{H}_2\text{O}$	$= \text{H}_2\ominus$
Peroxide of hydrogen . . .	$\text{H}_2\text{O}_2$	$= \text{H}_2\ominus_2$
Sulphuretted hydrogen . . .	$\text{H}_2\text{S}$	$= \text{H}_2\text{S}$
Bisulphide of hydrogen . . .	$\text{H}_2\text{S}_2$	$= \text{H}_2\text{S}_2$
Sulphurous acid . . . . .	$\text{SO}_2$	$= \text{S}\ominus_2$
Anhydrous sulphuric acid . . .	$\text{SO}_3$	$= \text{S}\ominus_3$
Hydrated sulphuric acid . . .	$\text{SO}_3, \text{H}_2\text{O}$	$= \text{SH}_2\ominus_4$
Anhydrous nitric acid . . . .	$\text{N}_2\text{O}_5$	$= \text{N}_2\ominus_5$
Nitrous acid . . . . .	$\text{N}_2\text{O}_3$	$= \text{N}_2\ominus_3$
Protoxide of nitrogen . . . .	$\text{N}_2\text{O}$	$= \text{N}_2\ominus$
Peroxide of barium . . . . .	$\text{BaO}_2$	$= \text{Ba}\ominus_2$
„ of manganese . . . . .	$\text{MnO}_2$	$= \text{Mn}\ominus_2$
„ of lead . . . . .	$\text{PbO}_2$	$= \text{Pb}\ominus_2$
„ of platinum . . . . .	$\text{PtO}_2$	$= \text{Pt}\ominus_2$
„ of tin, &c. . . . .	$\text{SnO}_2$	$= \text{Sn}\ominus_2$
Red oxide of manganese . . . .	$\text{Mn}_3\text{O}_4$	$= \text{Mn}_3\ominus_4$
Minium, &c. . . . .	$\text{Pb}_3\text{O}_4$	$= \text{Pb}_3\ominus_4$
Sesquioxide of iron . . . . .	$\text{Fe}_2\text{O}_3$	$= \text{Fe}_2\ominus_3$
Alumina, &c. . . . .	$\text{Al}_2\text{O}_3$	$= \text{Al}_2\ominus_3$
Platinous chloride . . . . .	$\text{PtCl}_2$	$= \text{PtCl}_2$
Platinic chloride . . . . .	$\text{PtCl}_4$	$= \text{PtCl}_4$
Stannous chloride . . . . .	$\text{SnCl}_2$	$= \text{SnCl}_2$
Stannic chloride . . . . .	$\text{SnCl}_4$	$= \text{SnCl}_4$
Ferric chloride . . . . .	$\text{Fe}_2\text{Cl}_6$	$= \text{Fe}_2\text{Cl}_6$
Aluminic chloride . . . . .	$\text{Al}_2\text{Cl}_6$	$= \text{Al}_2\text{Cl}_6$
Sulphate of alumina . . . . .	$3\text{SO}_3, \text{Al}_2\text{O}_3$	$= \text{S}_3\text{Al}_2\ominus_{12}$
Ferric sulphate, &c. . . . .	$3\text{SO}_3, \text{Fe}_2\text{O}_3$	$= \text{S}_3\text{Fe}_2\ominus_{12}$

It has been seen that we have barred the letters or symbols which represent elements whose atoms are double their equivalents. Berzelius formerly barred the letters which represented the *equivalents* of certain bodies, formed, according to him, of 2 atoms (double atoms). Our barred letters differ, then, from those of Berzelius, inasmuch as they represent atoms which we suppose indivisible. In other respects the bar is a purely conventional sign, but a convenient one, since it enables us to distinguish at the first glance the new notation from the equivalent notation. In adopting it, in this moment of transition, and, it must be said, of confusion, that embarrassment is avoided, which might arise in the mind of the reader by the use of formulæ to which he is not accustomed.

§ With regard to the oxalate and the tartrate, the coincidence of formulæ is accidental, and arises from the circumstance that Berzelius looked upon oxalic and tartaric acids as monobasic.

*On the Allotropic Condition of Silicium and Carbon in Cast Iron, and their Influence upon the Production of Steel by the Bessemer Process, by Dr. T. L. PHIPSON, F.C.S. London, late of the University of Bruxelles, &c.*

THE existence of carbon in two allotropic conditions in cast iron—viz., *a* C or combined carbon, and *b* C or graphite, and the influence these conditions exercise upon the quality of the metal and its applications to various purposes in the arts, has been for some time perfectly well known. The element silicium, which is always present in pig irons of every description, has not hitherto attracted attention in this respect. I have recently been fortunate enough, however, to ascertain by a series of analyses of irons of known qualities, that silicium, like carbon, exists in pig irons in two allotropic conditions—viz., *a* Si and *b* Si; and that the predominance of one or other of these forms in a given sample of iron has a very great influence upon the quality of the iron in question, and especially as concerns its capability for being converted into steel by the Bessemer process.

In the present paper I do not wish to enter into practical details resulting immediately from this unlooked-for discovery, but merely to point out as clearly as possible the existence of these two forms of silicium in some of our purest and best qualities of pig iron, as well as in irons of inferior qualities.\*

It is yet an undecided question whether the allotropic conditions of elements are generally carried with them into their combinations; the data we possess in this respect with regard to oxygen, sulphur, carbon, silicium, iodine, arsenic, mercury, phosphorus, tin, and some other simple bodies, are still insufficient to determine this important question. Doubtless such is often the case, and doubtless also the circumstances in which the compound is produced suffice already to change the particular allotropic condition of the element. But the fact I have determined, and to which I desire to call attention here is, that on analysing pig irons rich in silicium and carbon, such as are usually obtained in smelting the purest, but always highly siliciferous, red hematites, the former invariably splits up into two portions, *a* Si and *b* Si, and that it is according to the predominance of one of these portions over the other in any particular sort of iron, that this iron can, or cannot, be converted into steel by the Bessemer process.

This fact, of which I have convinced myself most completely, has hitherto escaped notice, and I have reasons to believe that it will sooner or later exercise a very important influence upon the manufacture of iron in general, and especially upon that of iron destined to be converted into steel.

It appears to be a matter of minor importance (phosphorus and sulphur being present in very minute quantities) how much carbon and silicium a pig iron contains in order that this iron may make good steel by the Bessemer process, provided the carbon and silicium be almost entirely in the free state—that is, as *b* C and *b* Si, and that the iron contain little or no *a* C and *a* Si (combined).

Phosphorus and sulphur having been recognised as highly detrimental substances in these irons, ores are sought which contain little or none of these elements but such ores are precisely those which usually contain the most silica. The red hematites of Lancashire have

\* I have been much aided in this interesting inquiry by the kindness with which Mr. F. H. Lloyd, the Superintendent of the steel manufacture, at Messrs. Lloyds' and Foster's Iron Works, has forwarded various specimens of irons to me, and given me all the information I could desire concerning them.



given me as an average of a very considerable number of analyses, 10 to 12 per cent. of silica; the red hematites of Germany have also yielded me an average of about 12 per cent.; the amount of silica in the English ores varying between 6 (minimum) and 26 (maximum) per cent. of silica in ores which are smelted at the present day. Now, a large amount of this silica, existing in the ore in the state of quartz, is reduced in the blast-furnace at the same time as the iron oxide, and, like carbon, the silicium produced combines with the metal in two distinct forms.

In analysing a pig iron we find invariably two kinds of carbon in it; the respective quantities of each may vary indefinitely according to circumstances tolerably well known, to which I cannot allude here; but *a* C and *b* C are always to be found. In the pig irons, obtained from red hematites or other ores comparatively free from phosphorus and sulphur, and excellent for the production of steel, it is *b* C which predominates largely. The same rule holds good for silicium: it is only those irons which contain *b* Si in large quantities, or rather, *a* Si in very small quantity, that can be used at all successfully for the production of Bessemer steel. On dissolving pig iron in acid *b* C is deposited in very brilliant scales of graphite, whilst *a* C escapes in combination with hydrogen, as a gas. Something very similar occurs for silicium: provided we use aqua regia as the solvent, which I consider necessary, both to prevent the formation of oxide of silicium, or the escape of any siliciuretted hydrogen, the whole of the silicic acid formed by *a* Si enters into solution, whilst that of *b* Si is deposited.

A quantitative analysis, showing merely the total amounts of silicium and carbon in pig iron free from phosphorus and sulphur, teaches us comparatively nothing with regard to the capability of this iron for being converted in steel, whilst an analysis which shows the amount of *a* C and *b* C, *a* Si and *b* Si, teaches us everything with regard to this question. In illustration of this, let us take the three samples of pig iron A, B, and C, which have yielded me centesimal compositions almost identical, but which are, however, of exceedingly different qualities:

	A	B	C
Total carbon . .	3.360	2.90	3.12
„ silicium . .	4.200	3.96	4.23
Phosphorus . .	0.013	0.01	0.01
Sulphur . .	0.021	0.05	0.06
Manganese . .	traces	0.01	traces
Iron . .	92.400	92.40	92.80
	99.994	99.33	100.22

I say these analyses teach us little or nothing; for why should A make tolerably good steel, B very inferior steel, and C steel so bad that it cannot be worked at all, which is found to be the case? The reason lies in the relative amounts of *a* Si and *b* Si present, as will be clearly seen in the annexed determination:—

		A	B	C
Carbon	{ <i>a</i> C .	0.30	0.40	0.30
	{ <i>b</i> C .	3.06	2.50	2.80
		3.36	2.90	3.12 percent.
		A	B	C
Silicium	{ <i>a</i> Si .	0.98	1.81	2.60
	{ <i>b</i> Si .	3.22	2.15	1.63
		4.20	3.96	4.23 percent.

It is easy here to see the progressive increase of *a* Si or combined silicium, corresponding precisely with the more and more inferior quality of the iron for steel

making. The specimen A must not be taken as the best type of iron for conversion into steel by the Bessemer process; many irons of better composition even than this are used; but it serves well to illustrate the case in point. In a future paper I hope to bring forward some observations on the determination of *a* and *b* silicium and *a* and *b* carbon in pig irons; a subject which requires rather more space than I can give it in the present note.

London, May 5.

*Researches on the Atomic Weight of Thorium, and on the Formula of Thorina,\* by M. M. DELAFONTAINE.*

BERZELIUS has attributed to thorium the atomic weight 74.5, being the mean of three analyses of thoric and thorico-potassic sulphates, in which he obtained 751.3, 741.73, 749.66, and 736.86; this number must be exchanged for 741.3, starting from the received equivalents of sulphur, barium, and potassium.

Berzelius's numbers not agreeing one with another, M. Delafontaine recommenced the study of thorium; he prepared thorina by means of two minerals—the orangite of Aröe and the thorite of Lövön. To obtain pure thorina, we proceed as follows:—We add water and concentrated sulphuric acid to the ore reduced to fine powder, so as to form a semi-fluid paste. The temperature of the mixture rises by itself sufficiently to cause a portion of the sulphuric acid to volatilise; we heat the residue to about 400° or 500° C. so long as it disengages acid vapours; then throw it in small portions into cold water, keeping it constantly stirred; then filter, concentrate the liquid, and heat it in a water-bath; sulphate of thorina, very slightly soluble in boiling water, will be deposited. After having been several times dissolved in cold water, and crystallised from a warm solution, the product may be considered pure, if by calcination it gives a perfectly white earth. The mother liquors, treated by sulphate of potash, give a double salt of thorina and potash. Pure sulphate of thorina is dense, white, and cheesy; it is composed of a multitude of small needles, which felt together. By adding to sulphate of thorina a quantity of water insufficient to dissolve it, it is in the space of one or two days transformed into colourless crystals, about three millimetres long.

To determine the equivalent, we used sulphate dried at 100° C. This salt purified several times by crystallisation with heat, until the portion remaining in solution has the same composition as that which is precipitated. The acid of the sulphate may be expelled by calcination. This salt does not attract moisture from the air; it has been exposed for three weeks without increasing in weight. The sulphate crystallised when cold, decomposes equally well by heat, but it has a great tendency to effloresce. Thorina obtained by calcining the first of these salts is a white, light earth, similar to magnesia; the other, much denser, forms a powder rough to the touch.

In the determinations made by the author, he dried the salts at about 400° or 500° C., and they did not lose their solubility in cold water. The anhydrous residue, heated to a bright red, until the weight remained constant, gave thorina, which served to determine the atomic weight. Three experiments gave the following numbers:—824.7, 823.1, 822.3, the mean of which is 823.3.

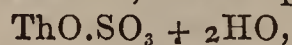
The difference between this mean and the number 841.3, found by Berzelius, is considerable; so to check his experiments the author made some further determi-

\* *Archives des Sciences Physiques et Naturelles*, xviii., 343. Abstract from *Bulletin Mensuel de la Société Chimique de Paris*, April, 1865, p. 278.

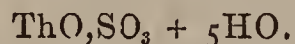


nations. After dissolving the salt in water he added oxalate of ammonia to precipitate the oxalate of thorina, which he calcined till completely decomposed; he then determined the quantity of sulphuric acid in the filtered liquid by means of chloride of barium. It was not possible to precipitate the sulphuric acid directly by chloride of barium, the sulphate of baryta then formed taking down with it part of the salt of thorina. The mean of fourteen determinations of thorina in the dried salt at  $100^{\circ}$  C. gave 52.51 per cent. of thorina; the mean of three estimations of sulphuric acid gave 31.92, and the equivalent of thorina, calculated according to these numbers, is 822.5, which agrees with the number above indicated. By subtracting the same two means from 100, there remains for the water 15.57.

Sulphate of thorina deposited in a boiling solution has, according to Berzelius, the composition—

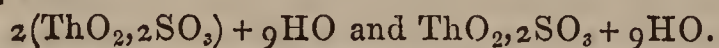


and that which crystallises in a cold solution—



According to his own analyses, the author gives, for the first,  $4(\text{ThO} \cdot \text{SO}_3) + 9\text{H}_2\text{O}$ , and for the second  $\text{ThO} \cdot \text{SO}_3 + 9\text{H}_2\text{O}$ . It has never been shown that thorina was a base of the form RO; Berzelius supposed it possible, because in the thorico-potassic sulphate the sulphuric acid is divided between the two bases, but it would be so still were this salt represented by  $\text{ThO}_2 \cdot 2\text{SO}_3 + 2(\text{K}_2\text{O} \cdot \text{SO}_3)$ , instead of  $\text{ThO} \cdot \text{SO}_3 + \text{K}_2\text{O} \cdot \text{SO}_3$ .

MM. Mordenskiöld and Chydenius† have stated that thorina crystallises by the dry way in the same form as stannic and titanic acids. It would not then be impossible that the formula of thorina, as well as that of zircon, which so much resembles thorina, should contain one atom of metal and two of oxygen. If such be the case, simpler formula correspond to the analyses; they become, by making the atomic weight of thorina = 1646.6.



The quantity of water in the first salt is, indeed, fractional, but there are other examples of this fact, for the sulphates of uranium, cadmium, yttrium and didymium contain on  $\frac{7}{2}$  and the others  $\frac{8}{3}$  equivalents of water. However that may be, the author proposes 1646.6 or 263.5 ( $\text{O} = 16$ ) for the equivalent of thorina, and 1446.6 or 231.5 ( $\text{O} = 16$ ) for that of thorium.

The author, who finished his memoir at the same time that M. Chydenius‡ published his researches on the salts of thorina, differs from him on several points. According to M. Chydenius, sulphate of thorina contains an atom and a-half, sometimes even a single atom of water, and loses it altogether at a temperature of about  $235^{\circ}$  Centigrade. M. Delafontaine has never observed any variation in the proportion of water in a sulphate.

Five series of experiments, with a maximum of 861 and a minimum of 814, have led M. Chydenius to the mean 840.5 for the equivalent of thorina. The salts which have served to establish these numbers are the acetate, formiate, oxalate, and sulphate of thorina and thorico-potassic sulphate. As to the first two salts, thorina is so feeble a base, and formic and acetic acids are so volatile, that there is always a probability of losing a small quantity of these acids by drying at  $100^{\circ}$  Centigrade. Moreover, the acetate is insoluble and the formiate decomposes even in cold water; they can then hardly be purified by repeated crystallisations.

The oxalate leaves by calcination 59.40 per cent. of base, the mean of six operations, from which is deduced 823.1 as the equivalent of thorina. This number is close to that of M. Delafontaine, but it differs widely from 841.8, deduced from Berzelius's analyses of sulphate. The difference is probably attributable to the process of analysis employed for the latter salt.§

Though M. Chydenius has established the isomorphism of thorina with oxides with two atoms of oxygen, he nevertheless preserves the formula ThO proposed by Berzelius. The analysis of different fluothorates lends fresh support to M. Delafontaine's opinion; for, by doubling the equivalent of thorium the formulas of these compounds become analogous to those of the fluozirconates described by M. Marignac.

M. Delafontaine's first experiments were founded entirely on those of Berzelius; sulphate of thorina precipitated by caustic potash deposits the base, the weight of which, compared with that of sulphuric acid, obtained by treating the filtered liquid by chloride of barium gives the required atomic weight. However carefully it may be washed, the proportion of thorina varies between 53 and 55 per cent.; hence the author gives the preference to the results furnished by the calcination of sulphate. Thoric hydrate is gelatinous, but instead of remaining long in suspension in the water it easily falls to the bottom of the vessel. When thrown on the filter it quickly cracks, often even before losing all the water. The washing is thus made much more uncertain.

#### Researches on Black Phosphorus,|| by M. le Dr. BLONDLOT.

THE colour of crystallisable phosphorus presents three varieties—it may be white, yellow, or black. The last variety discovered by Thenard can only be reproduced accidentally, and indeed its existence has been doubted by most chemists.

Endeavouring to find out the secret of this preparation, I found that agreeably to Thenard's opinion the colour of phosphorus owes its degree to the way in which it is cooled after having been melted.

Phosphorus is, as we know, purified by distillation. I perform this operation in a current of hydrogen by means of a small tubular retort, heated in a sand bath, and adapted to a flask half full of water, resting at the bottom of a large vessel filled with water at  $70^{\circ}$ . On dismounting the apparatus there is usually found a certain quantity of red phosphorus at the bottom of the retort. Now from what I have observed it is in the production, and in the successive elimination of the latter that the conversion of ordinary yellow into white and reputed pure phosphorus consists. I also found that to insure success in bleaching phosphorus by repeated distillations, it is necessary between each operation to submit it to insolation in glass tubes, so as to convert the yellow part which is volatile into red phosphorus, which is fixed. When bleached in this way phosphorus has a strong tendency to turn suddenly black. Rapid cooling may produce this effect, as Thenard has shown; he obtained this result by melting his phosphorus in fine tubes, which he then plunged into cold water. Melted again, the black phosphorus thus produced lost its colour, and did not regain it till it had been rapidly cooled. Hence it has been inferred that black phosphorus is the result of a kind of tempering. This is an error, for I have obtained it more easily in quite a con-

† Poggendorff's *Annalen der Physik und Chemie*, cx., 642, and *Reper- toire de Chimie Pure*, 1861, p. 118.

‡ See *Bulletin de la Société Chimique*, i., 130.

§ See *Repertoire de Chimie pure*, 1861, p. 39, and *Annales de Chimie et de Physique*, lx., 12.

|| *Comptes Rendus*, lx., 830.



trary way—that is to say, by very gradual cooling. In this way I habitually procure black phosphorus. For this purpose I distil phosphorus, previously insolated, until the product collected in the balloon very slowly cooled in the water-bath suddenly turns black. This curious change generally takes place in the following manner:—When the temperature has fallen to about  $44^{\circ}$ , the phosphorus solidifies in the usual way into a white mass; then, when after several hours the water is only at  $5^{\circ}$  or  $6^{\circ}$ , the phosphorus suddenly—in the space of a second—turns to a beautiful black. Black phosphorus, when once obtained, may be re-melted and re-distilled without fear. When liquid it is colourless, but returns to black by very slow cooling. It presents, moreover, all the characteristic properties of ordinary phosphorus, except that it is softer.

It follows from the above researches that as yellow phosphorus is recognised as impure, and as the white is but a transitory state before arriving at the black, the latter, much more stable, should be considered not as an anomaly, but, on the contrary, as the true type. A support for this opinion is to be found in the fact that phosphorus which has been long exposed to diffused light, and has become covered with a layer of red, is found to be black inside, as though, in becoming spontaneously purified, it had undergone a molecular change somewhat analogous to crystallisation.

*On Combinations of Boron with Chlorine and Bromine,\**  
by M. J. NICKLES.

ANHYDROUS boracic acid, dissolved in absolute alcohol and treated by a current of hydrochloric or dry hydrobromic acid, exchanges its oxygen for chlorine or bromine, so that chloride or bromide of boron is formed, which remains in combination with the organic molecule.

**Chloride of Boron,  $\text{BoCl}_3$ .**—As Ebelmen has shown, anhydrous boracic acid is soluble in absolute alcohol. Such a solution quickly absorbs the hydrochloric gas, and becomes oily. It fumes in the air; water decomposes it, producing boracic and hydrochloric acids and alcohol. It is not volatile, though it emits vapours containing a little chloride of boron.

Though this liquid seems to be merely an alcoholic solution of boracic acid saturated with hydrochloric gas, its composition is very constant, and is exactly represented by the formula—

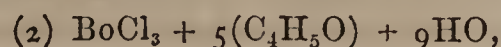


In fact—

	Calculated.	Found.
$\text{Cl}_3$ . . .	24.42	24.41
$\text{C}_{20}$ . . .	27.52	27.65
$\text{H}_{33}$ . . .	7.56	7.72

Heated, it emits volumes of boraciferous hydrochloric gas; the thermometer rises rapidly, and stops at  $85^{\circ}$ . The residue is boracic acid.

The volatile part is hydrated chloroboracic ether having the formula—



deduced from the following results:—

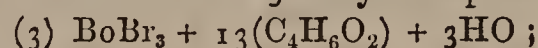
	Calculated.	Found.
$\text{Cl}_3$ . . .	27.91	27.88
$\text{C}_{20}$ . . .	30.23	30.92
$\text{H}_{31}$ . . .	8.8	8.60

This, it will be seen, closely resembles the elementary composition of (1), the boracic acid being deducted.

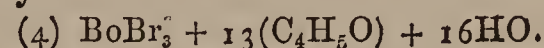
With the same acid, anhydrous ether, and dry hydrochloric gas, analogous results are obtained, always with the condition of heating for some time at  $100^{\circ}$  in a closed vessel.

**Bromide of Boron,  $\text{BoBr}_3$ .**—Hydrobromic acid gives nearly the same results as hydrochloric acid. On distilling the alcoholic liquid obtained by saturating boracic acid with hydrobromic acid, the thermometer stops at  $92^{\circ}$  C. The product of the distillation is composed of two superposed liquids, which, rectified separately, are reduced to one and the same ether, the boiling point of which rises gradually, but does not pass  $135^{\circ}$ . The residue is composed of a little boracic acid.

The liquid collected at  $115^{\circ}$  may be represented by—



or, rather, by



In fact—

	Calculation.	Found.
$\text{Br}_3$ . . .	27.39	27.36
$\text{C}_{52}$ . . .	35.61	35.70 35.84
$\text{H}_{81}$ . . .	9.24	9.50

All these ethers resemble each other in their corrosive taste, the white fumes they emit and which coats the surrounding bodies with boracic acid, and finally in the property of turning brown certain vegetable yellows, such as turmeric. The vapours produce the same effect; however, this reaction takes place only when the coloured paper is dry, for the tint is not developed in presence of water, the boron having turned to boracic acid.

The presence, in definite proportions, of boron, bromine, and chlorine, prevents my seeing in them the boric ethers obtained by MM. Ebelmen and Bouquet, with alcohol and chloride of boron.† These may be produced by distilling the new ethers with some alcohol, which will effect the transformation of the chloride or bromide of boron into boracic acid. The necessity of preparing chloride of boron is thus avoided, an operation so difficult and costly that some other means of preparing boracic ether has long been desired.

The new compounds (2) and (4) behave with peroxides in the same way as ether charged with hydrochloric acid—that is to say, they transform them into perchlorides and perbromides. Sesquioxides are acted on in the same way.

THE

DUBLIN INTERNATIONAL EXHIBITION.

By CHAS. R. C. TICHBORNE, F.C.S., F.R.G.S.I., &c.

(Specially Reported for the CHEMICAL NEWS.)

ON Tuesday, May 9, 1865, the Dublin International Exhibition was opened with all the pomp and grandeur attendant upon such events. The Heir Apparent to the Throne—amongst a host of coronets, military plumes, judges' wigs, mayors' gowns—inaugurated the magnificent building yclep't the Winter Gardens, by declaring the Exhibition opened. Neither was science or literature unrepresented upon that occasion. The following well-known names were noticed:—The Lord Chancellor, Lord Rosse, Sir Edward Landseer, Sir David Brewster, Dr. Lyon Playfair, Sir Robert Kane, Professor Bentley, A. Brady, A. Claudet, Owen Jones, Thomas Fairbairn, T. M. Fairholt, J. H. Foley, Captain Fowke, S. C. Hall, R. Thompson, H. Way, Digby Wyatt, P. Le Neve Foster,

† "Recueil des Navaux Scientifiques," de M. Ebelmen, i., 105. Paris: Mallet-Bachelier.

\* Comptes Rendus, lx., 800. 65.



Parry (*Illustrated London News*), President of the Royal College of Physicians, President of the Royal College of Surgeons, Professor T. Archer, B. Guinness, Professor Sullivan, Sir R. Griffith, Sir B. Burke, &c., &c. Indeed, it was what in national parlance would be called "a great day for Ireland."

The origin and history of the Dublin Exhibition may be told in a few words. The idea of a winter garden emanated from Mr. H. Parkinson, the present secretary, and was warmly taken up by Mr. Guinness and other members of the committee. A company was formed for the purpose of providing an exhibition palace after the model of the Crystal Palace at Sydenham, but on a scale suitable to the population of the city. A tract of about seventeen acres in extent, formerly known as the "Coburg Gardens" lying within a few minutes' walk from the busiest centre of the city, having passed into the possession of Mr. Benjamin Lee Guinness, that gentleman, with his characteristic liberality in the promotion of all that can add to the comfort and happiness of his fellow citizens, placed the land at the disposal of the newly formed company at the price for which he had purchased it.

The first stone of the building was laid in March, 1863, by the late Earl of Carlisle. As the buildings advanced their suitability for the purpose soon suggested the idea of inaugurating the new institution by holding an international exhibition, nothing of that kind on a large scale having been attempted in Ireland since the exhibition of 1853, known as the Dargan Exhibition, and which was opened by her Majesty.

To accomplish this enterprise a new organisation was resolved on, and the Company leased their premises at a fixed rent for the period of the Exhibition to the present executive committee.

The precedents of former exhibitions, and especially that of 1862, have been followed as far as circumstances admitted.

The objects for exhibition have been divided into six great classes, five containing the industrial products, and the sixth comprehending every branch of the arts—i.e., Raw materials, textile fabrics, metallic, vitreous and ceramic manufactures, miscellaneous manufactures, and fine arts. Under the first denomination are included mining and quarrying processes and mineral products, chemical substances and articles of food. Under the second we find not only machinery in motion and at rest, but philosophical and musical instruments and implements of modern warfare. The third department is occupied by fabrics of cotton, wool, silk, lace, and leather. The fourth by products of the smith and potter. Under the head of miscellaneous come articles required for decoration. Photography is included in the fine arts, and many specimens of delicate workmanship usually classed as jewellery belong to the same denomination. But in an international exhibition additional complication arises from the fact that the division of products into these six classes is co-ordinate with their division into national departments.

The space has been mapped out in accordance with the following plan:—France has been assigned the circular "apse" and its galleries. Prussia and Austria have the western side and galleries of the southern transept. Belgium and Holland and Germany the eastern side. The French stands occupy, in addition to the apse, a large extent of the northern transept and its galleries, and opposite to them is the space allotted for Italy, Rome, and Switzerland. Denmark, Norway, and Sweden have the corners of the northern

transept, but the whole of the great glass hall which stretches from this along the side of the main building is devoted to home and colonial manufactures. A Committee of Advice, composed of gentlemen selected for their special knowledge, took charge of each class. In London the Society of Arts gave their timely and cordial support.

Her Majesty has sent many valuable contributions from the Royal collections, and has officially introduced the Exhibition to the authorities of the British colonies and foreign Governments. Most of these Governments have deputed special representatives to attend and to oversee the interests of the exhibitors from their respective countries, and to aid in the selection of the jurors who will early in June adjudicate upon the merits of the productions.

Like all Irish exhibitions, it is more of an art exhibition than one of raw materials and machinery. The fine arts proper—viz., sculpture, painting, and photography, are well represented, and decorative art as applied to textile fabrics, metallic and pottery manufactures, are there in abundance; but there is a falling off from the exhibitions of Great Britain as regards the raw materials, therefore the chemical reporter has not the work before him which he had premeditated before the memorable 9th of May when the gate "op'd his ponderous and marble jaws" to the curious and expectant crowd; but there is still enough to interest and instruct even in our own strict department. Many new phases have cropped out through the instrumentality of our own splendid science since the Exhibition of 1862. Although only two or three years have elapsed, science has been going at an electric pace, and the accessories must keep up with the rush. In the words of the author of that masterpiece of reports,\* "Progress, rapid and important, in all branches of art and manufactures—such, broadly and briefly stated, is the gratifying result elicited by a general comparison. Everywhere his eye will be met by proofs of the all-pervading influence of chemistry in the development of the arts; everywhere he will see new materials, elementary or compound, placed by chemistry at the artificer's disposal; finer and more delicate results of all kinds achieved by aid of the knowledge due to chemical investigation."

**Precious Metals, &c., British Department.**—Perhaps one of the most interesting cases in the Exhibition is Messrs. Johnson, Matthey, and Company's case of precious metals. For although it may contain nothing of absolute novelty, the very rare and beautiful specimens must elicit a certain amount of admiration even from those who are not acquainted with the difficulty which is experienced in procuring such substances as are here exhibited. The principal things in this case are platinum boilers, alembics, syphons, tubing, and capsules, &c., which are soldered by what Messrs. Johnson and Co. call the patent autogenous process—this euphonious name expresses, as we suppose, the fusing of the platinum seams together, by which the use of gold is avoided. A boiler for the rectification of sulphuric acid is exhibited, valued at 1500*l.*, and capable of rectifying to the full strength three tons of sulphuric acid per day. The firm makes boilers with all the recent improvements capable of concentrating from half a ton to ten tons of acid per day.

*Apropos* of platinum sulphuric acid stills, there can be no doubt that the large manufacturers of sulphuric acid are reverting back to the old plan of concentrating

\* Report upon the Exhibition of 1862, Section A, Chemical Products and Processes.



in glass. The great wear and tear produced upon the platinum by the sulphuric acid (especially when containing nitrogenous products), combined with the interest of capital sunk, have induced the manufacturers to return to their old love. Dr. Hofmann, in his Exhibition Report, refers to this fact, but mentions at the same time that the platinum seems still to hold its ground in France. The writer of the present report paid a visit last winter to one of the largest sulphuric acid manufacturers in England, and found that he had completely discarded the platinum. The great disadvantage occurring from the frequent breakage of the glass has been in a great measure overcome by the judicious choice of glass suited to the purpose, a careful tempering of the alembics after they are made, and the exclusion of the exposed parts of the vessels, when working, from currents of cold air. The alembics are generally placed in rows on each side of a long chamber, and the number of fires naturally conduce towards an atmosphere the temperature of which is a guarantee against unequal expansion, providing nothing comes in actual contact with the glass. The retorts are worked continuously, being filled with hot acid.

M. Scheurer-Kestner says that in an apparatus producing 4000 kilogrammes 1000 kilogrammes were found to dissolve, and to carry off two grammes of platinum; when the sulphuric acid contains nitrous vapours, this quantity was increased to four or five grammes. But according to M. Kestner the alloy of platinum and iridium is comparatively unacted upon by boiling sulphuric acid.†

Messrs. J. and M. show a specimen of this alloy, but we are not aware that any practical attempts have been made towards its use in the construction of sulphuric acid stills. An alloy of this metal and osmium is also shown, which is used for pen points.

There are exhibited also in this case some specimens of platinum gauze, which, we may suggest, might find some uses in connection with chemical gas burners, and would be also applicable to laying under the combustion tube in an organic analysis.

The same firm likewise exhibit copper vessels plated with platinum, which are worthy of a more extended application for chemical purposes.

A model of the ingot of pure platinum is shown, "melted by the intense heat of combined gases." Weight, 3200 ounces; value, 3840*l*. Palladium and some of its salts are here exhibited. We may mention that this metal seems to have now become extremely rare, probably from the fact that the native platinum now worked in this country does not contain much palladium. Splendid crystals of chloroplatinate of sodium are exhibited; some of them more than an inch in length.

Bismuth is represented by a fine iridescent specimen composed of distinct crystals.

The specimens of trichloride of gold exhibited by this firm are very fine, and are worthy of a special notice. The salt as exhibited by Messrs. Johnson and Matthey is of a bright orange colour, and in distinct needles, perfectly dry. The mode in which this appearance is

procured is by one of those simple trade manipulations which, although not mentioned in books, are often of the utmost importance as regards the appearance of the manufactured article. From the ready solubility of trichloride and its deliquescent nature, it is necessary to evaporate the solution until it will set into a dark-red and crystalline mass on cooling. But by allowing the solution to cool slowly to a point somewhat short of its actual solidification, and then pouring off from the crystals already formed the still fluid portion, a mass is procured of the most brilliant colours, and consisting of a network of distinct prisms. The product procured in this manner is less hygroscopic than the ordinary salt.

The specimens of nitrate of silver and lunar caustic are excellent, and we have samples of what is called triple crystallised nitrate for photographic purposes. The product is certainly very pure and neutral; so exactly neutral is it, that the writer has observed that most of the distilled water, as sold, gives a decided opalescence with this salt—particularly if the water has been distilled some time, and contains in consequence any microscopic vegetation. They also show a platinum pyrometer (patent) described as "a novel application of the spiral coil of a compound laminæ of two metals of unequal expansion by heat."

But perhaps the most interesting in a scientific point of view are a few rare metals and non-metallic elements which are here. These include two magnificent specimens of graphitoidal boron and silicium, the latter forming a very beautiful object. Iridium, rhodium, osmium, ruthenium, tellurium, selenium, cæsium, and rubidium.

Pitch blende, uranium, and its pretty greenish-yellow salts are also exhibited. The patent sunlight, magnesium, is also here in great force, but your readers are so conversant with its properties that it is needless to dwell upon the subject.

(To be continued.)

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, June 1.

Professor A. W. WILLIAMSON, Ph.D., F.R.S., Vice-President, in the Chair.

IN continuation of our report of the proceedings of the ordinary meeting of June 1 (at page 270), we resume the subject of Dr. Miller's discourse upon "*Some Points in the Analysis of Potable Waters.*" After describing the methods for determining the amounts of organic matter and nitric acid, the author referred to the estimation of ammonia. For this purpose a deci-gallon of the water is mixed with about one fluid ounce of baryta water, and distilled until one-fourth part of the contents of the retort have passed over; the liquid remaining in the latter may be conveniently employed for the detection of nitric acid, whilst the distillate is divided into two equal parts, one of which is immediately tested for ammonia by Nessler's solution (*i.e.*, iodide of mercury dissolved in aqueous iodide of potassium, and an excess of caustic potash afterwards added). In the event of ammonia being present in large quantity a precipitate is formed, but in most cases a yellow colouration only is the result; and inasmuch as it is desirable to employ this method of examination as a colour-test, Dr. Miller recommends that the ammoniacal distillate should be further diluted, if necessary, until nothing amounting to a precipitate is produced on addition of the mercurial compound, the reserved half of the liquid being available for this purpose. So delicate is this test that '003 grain of ammonia is sufficient to show

\* Two capsules—one of platinum and the second of platiniridium alloy—were introduced into a platinum alembic, and exposed for two months to the action of boiling sulphuric acid. The capsule of pure platinum was entirely deformed, and its surface corroded. It had lost not less than 19·66 per cent. of its weight. This capsule of iridio-platinum, on the other hand, was found to have retained its form; the surface had remained brilliant, and the loss did not amount to more than 8·88 per cent. of its weight. The loss of the second capsule is accordingly not more than 45 per cent. of the loss of the pure platinum vessel."



a decided yellow colouration, and the depth of tint observed in a quantitative experiment is compared with the result furnished by a highly dilute solution of sal-ammoniac of known strength. Whilst giving the preference to this mode of determining the ammonia, the author stated that larger amounts might be treated at once with standard acid according to the usual process of alkalimetry. The methods of estimating chlorine, sulphuric acid, potassium, and sodium did not call for any special remark; but with regard to calcium Dr. Miller stated that he was accustomed to overcome the difficulties of burning the oxalate by heating in a muffle to a very high temperature, when pure caustic lime remained as the product to be weighed. The lecturer then adverted to the presence of free oxygen in water, and showed a very convenient apparatus for expelling this gas by ebullition, and collecting it over mercury. It consisted of a glass balloon, of one decigallon capacity, in which the water was boiled, surmounted by a delivery tube expanded into a bulb immediately above the neck of the flask, and which served to return a large proportion of the condensed water. The outlet of the delivery tube dipping into the mercury trough was overlaid with caoutchouc, which prevented the violent concussions usually resulting from the sudden condensation of steam. Dr. Miller exhibited his transfer tube, with flexible joints, which might then be conveniently employed in the removal of part or the whole of the oxygen for endiometric analysis; and concluded with some excellent remarks upon the general mode of stating the analytical results and of associating the acid and basic constituents: the results should, he thought, be reported on a decimal system (if the litre itself be not adopted), besides stating for the information of the general public in grains per gallon. He considered it likewise advantageous to show in a supplementary table the proportions of chlorine, calcium, magnesium, &c., actually found, which would facilitate the comparison of independent analyses, and show facts with the least possible garb of theory.

The CHAIRMAN commented upon the value of the ammonia test proposed by Dr. Miller, and referred to the discrepancies which often occurred in reporting the analyses of water.

Dr. FRANKLAND offered a remark to the effect that he should not be satisfied with an analytical statement which did not show the mode of union presumed to exist in the case of the several acids and bases discovered in the water.

Dr. MILLER here explained that he was urging the desirability of showing two tables—one would indicate the proximate constituents actually discovered and the other the forms of combination presumed to occur. With respect to the mercury test for ammonia, he desired to give Mr. Hadow the credit of having suggested its employment in the manner just now recommended.

Mr. DUGALD CAMPBELL hesitated in placing reliance upon the use of permanganate of potassium as a reagent for the determination of organic matter in waters. About fourteen years ago Dr. Clark and himself made a series of experiments under the precise conditions which had been described, but without arriving at satisfactory results, for the same water required varying proportions of the permanganate according to the degree of concentration, and would, after keeping some time, decolourise more of the test than when freshly collected. The speaker then referred to the anomalous action of magnesium salts in interfering with the action of the soap test as proposed by Dr. Clark, and said that the alkalinity of a water was a property which should be observed, inasmuch as the deep well waters of London contained carbonate of sodium.

Dr. VOELCHER mentioned an anomalous result which happened in his personal experience whilst taking the "hardness" of a sample of river water. From some cause which he could not fathom the degree of hardness became increased upon boiling, and the results were the

same whether the ebullition were continued for one, two, or three hours.

Dr. BACHHOFFNER said it was very desirable that some uniform standard should be agreed upon for stating the amount of organic matter in waters. It was customary for the late Dr. Thomson to report this impurity in grains per gallon, and to quote the Marylebone pump-water, and the question became one of importance when it was known that there were Officers of Health in every parish interested in the promulgation of exact data as a standard of comparison.

Dr. ODLING said that although a table showing the elementary constituents would be useful to the chemist as a means of comparing results, it would not satisfy the general public, who preferred the information to which they became habituated. A determined effort in the direction of following Dr. A. W. Hofmann's monthly report in the *Times* would surely lead to the general adoption of a new mode of stating the amount of oxidisable matters present in any given sample of water; but with regard to the permanganate test, it became a matter of importance to know precisely the degree of delicacy. Was it affected by temperature, or by dilution? and, further, had it been ascertained whether equal quantities of the red solution exactly corresponded with equal amounts of organic matter destroyed? In a paper read before the British Association at Bath, Mr. Vernon Harcourt showed that the presence of the manganous salt exerted an influence upon the action of the permanganate, and consequently the first and last portions of organic matter would be destroyed under different conditions. With respect to the property termed "hardness," it would be remembered that Dr. Nicholson, in a paper on "*Water Analysis*" read before the Society, distinctly affirmed that carbonic acid affected the soap-test, and was a cause of hardness. Dr. Parkes found less difficulty in making use of a soft potassa soap, which he standardised with chloride of barium.

Mr. VERNON HARCOURT made a statement relative to the oxidation of oxalic acid by permanganate of potassium, which he found to be more rapidly accomplished in the presence of a manganese salt, such as the sulphate or chloride. He had made experiments in which the permanganate was employed in great excess for the purpose of ensuring the total destruction of the oxalic acid or other organic compound, and the excess afterwards allowed for by reducing with a known quantity of ferrous sulphate, and again adding permanganate until the colour was persistent; also in other instances the excess of the red solution was got rid of by iodide of potassium and subsequent employment of a standard solution of hyposulphite of sodium.

Dr. MILLER, by way of reply, said that the permanganate test for organic matter had not succeeded in his hands when he employed that salt in great excess, and afterwards proceeded to determine the amount of surplus; but he found the results very fairly uniform when the experiment was conducted in the cold and in the manner described. Whenever a sample of water contained both organic matter and nitrates, it was impossible to arrive at a decisive result by the incineration of the dry saline residue, and he found likewise that sulphates were reduced to sulphides by the deoxidising action of the carbon compounds. He quite concurred in Dr. Odling's opinion about the mode of reporting the results; and now that it was understood that Dr. Frankland would in future send the periodical reports to the newspapers, he begged him to act upon the suggestion, for he would have the opportunity of "speaking with a very large trumpet." The use of chloride of barium in connection with the soap test should not, he thought, be recommended, since it was possible that it might behave in the indefinite manner evidenced in the case of the chloride of magnesium.

The CHAIRMAN, in moving a vote of thanks to Dr.



Miller, which was warmly responded to, took occasion to request that he would favour the Society with a written statement of the main facts of his interesting communication for the purpose of being printed in the journal.

The meeting was then adjourned, as already announced.

# ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 31.

"On Scientific Experiments in Balloons." By JAMES GLAISHER, Esq., F.R.S., &c.

MR. GLAISHER, at the beginning, referred to the discourse given by him two years since, when he had made eight ascents, for the purpose of scientific researches in the higher regions of the atmosphere, and said since that time he had made seventeen additional. He described the process of filling a large balloon, and briefly described a balloon ascent, speaking of the novel sensation at first experienced, of the extreme coldness and dryness of the air at great elevations, of the painless death awaiting the aerial traveller who should ascend to an elevation too great for his power of endurance, and compared it to that of the mountain traveller, who, benumbed and insensible to suffering, yields to the lethargy of approaching sleep, and reposes to wake no more. Moral energy in both cases, he stated, was the only means of safety.

He then exhibited the several instruments used, pointing out their extreme sensitiveness and delicacy, and then spoke of balloon research.

The subjects of research by means of balloons, he said, were:—

1st. To determine the rate of decrease of temperature with increase of elevation, and to ascertain whether the results obtained by observations on mountain sides—viz., a lowering of temperature of  $1^{\circ}$  for every increase of elevation of 300 feet—be true or not.

2nd. To determine the distribution of the water, in the invisible shape of vapour, in the air below the clouds, in the clouds, and above them, at different elevations.

3rd. To compare the results, as found by different instruments, together:—

1. The temperature of the dew-point, as found by—

Dry and wet thermometers—(free).

Dry and wet thermometers—(aspirated, or air made to pass rapidly).

Daniell's dew point.

Regnault's dew point—(blowing).

Regnault's dew point—(air made to pass rapidly).

2. To compare the readings of—

Mercurial and aneroid barometers, &c.

4th. Solar radiation, by taking readings of the blackened bulb thermometer fully exposed to the sun, with simultaneous observations of the dry bulb thermometer, and also of observations of Herschel's actinometer.

5th. To determine whether the solar spectrum, when viewed from the earth, and far above it, exhibited any difference; whether there were a greater or less number of dark lines crossing it, particularly when near sun-setting.

6th. To determine whether the horizontal intensity of the earth's magnetism was less or greater with elevation. Propagation of sound. Amount of ozone, &c.

We have only space for some general remarks on the two first heads, and the summary of the observations on solar radiation. On the two last subjects no observations appear to have been made.

The speaker said it is very clear from the particulars of each ascent that they cannot all be combined, or all used in deducing general laws. Those ascents which have been made during the past year under similar circumstances to those from which the laws of decrease of temperature were found, when combined do not change the values previously found to any great amount; but those which have been made under other circumstances, such as in the winter and at times of the setting sun, differ very greatly indeed.

The deviation from this law, however, in winter is certainly of the highest importance to us, the meeting of a strong current of air from the S.W. of so great a depth as nearly one mile, over our country on January 12, in the season of winter, which current I know continued many days, must have exercised great influence. This was the first instance of meeting with a stream of air of higher temperature than on the earth; above this the air was dry, and higher still it was very dry; fine granular snow was falling thickly above this warm stream of air.

The S.W. current being thus observed is of the highest importance as bearing upon the very high mean temperature we experience during the winter—so much higher than is due to our position on the earth's surface; and it is highly probable that to its fluctuations the variations of our winters are due.

Our high winter temperature has hitherto been referred for the most part to the influence of the heated water of the Gulf Stream; but if this were the case the same agency, being at work around the coast of France, should exercise the same influence; yet we know that the winters of France are more severe than our own, though situated so much south of us.

Dr. Stark, of Edinburgh, some years since referred the mildness of the winters in Britain for the most part to prevalence of the S.W. or anti-trade wind, which is the prevailing aerial current in this latitude during winter.

He observes, so long as these winds blow, we have no frosts or intense colds; but the moment the wind changes during winter to an easterly, north-easterly, or northerly direction, we have both frost and snow, and more or less intense cold.

The S.W. winds in their course meet with no obstruction in coming to us, but they blow directly to us and to Norway over the Atlantic; and hence we enjoy a much milder climate during winter than any other lands not similarly situated with regard to such winds.

The south-west winds cannot reach France till they have crossed the whole of Spain and the high mountain range of the Pyrenees; and by the time they have crossed that mountainous country they are so much cooled that France can derive comparatively little benefit from them, and hence apparently her more severe winters.

Another fact may be inferred from this winter trip; it has always been a matter of great difficulty to me to account for the simultaneous appearance of dense fog over the whole country, and extending far out to sea; but the fact of a warm current of air, situated under a mass of snow falling, would fully account for the production of any amount of fog.

Another inference may be drawn from the facts noticed. One only I will mention, and it is this: If during the prevalence of a warm current of air passing over these islands there can be currents of air of so low a temperature as I experienced, it is evident that as it is but a struggle between two or more forces, either of which may preponderate at any moment, it is not safe, therefore, in the winter months, how mild soever the weather may be, to go thinly clothed at any time, for at any moment this warm current may be deflected, and its place occupied by the cold current, and thus some of our sudden and apparently unaccountable changes may be due.

The fact of no change of temperature being met with at the time of sunset on June 13, for 2000 feet from the earth, that a much smaller change took place than usual on June 20, a little before sunset; and that on June 27, after sunset, as well as could be determined, the change to 3000 feet was small, it would seem that the laws which hold good by day do not hold good by night; indeed, it seems probable that at night, for some little distance, the temperature may increase with elevation instead of decreasing. This can only be determined by experiments at night.

Comparing the results of one experiment with another



with respect to the moisture in the air, at the same elevation, it is found to be very different at different times; and that on the same day the moisture is very differently distributed, there having been on some of the days of experiments several successive wet and dry strata placed one above the other.

The variation in this climate, its frequent disturbed atmosphere, the smallness of the country, causing great anxiety after passing through clouds and out of sight of the earth, for fear of descending over the sea, when the balloon has no longer power to keep up, rendering each experiment limited in its duration, that perhaps this country is not the best for determining the laws which govern atmospheric changes.

I am glad to learn that similar observations are contemplated being made in France, and I hope that similar observations will be made in other countries, for it is probable that above the large plains of the Continent, where the weather is more uniform, and where an observer can be for hours out of sight of land without anxiety—that the experiments can be more easily made, and probably, too, the general laws made more easily apparent.

Many ascents will, however, be necessary; clouds as large, and clouds far colder than any I have met with, were experienced by Messrs. Bixio and Barral, in their ascents in June and July, 1850, from Paris. These gentlemen made two ascents for scientific purposes, and although from accidents the ascents were of short duration, the results were of high interest. Among them they noticed that they passed through a cloud of icicles, which sustained themselves in the air, as it appeared to them, contrary to the laws of gravity; but upon their horizontal surfaces they saw beneath them, however, an exact image of the sun, formed by the reflection of the luminous rays on the crystals of ice, floating about in a foggy atmosphere; and they noticed the temperature of the cloud to be as low as minus  $40^{\circ}$ , a far greater degree of cold than I ever experienced.

With such variations as these, as many ascents will be necessary to be made in France as in England, to determine general laws; but each ascent may be made far richer in results than any one in England. In France, the duration of a journey will be limited only by the wishes of the observer, and not as here by the sea, or by one solitary hour's observations—that being the time frequently in which we approach the sea.

It is certain that there are in the higher regions of the earth's atmosphere spaces subjected to great cold, and others to considerable heat; that there exist some clouds of very low temperature; and some, as those passed through on January 12, for a mile in thickness, of comparatively high temperature.

The presence of such, either cold or hot currents, passing over the country, must play an important part in all our meteorological phenomena, and must exert a great influence upon our climate.

When I first undertook to make these experiments, I expected that a few ascents would have given the information sought; the number of experiments I have now made is twenty-five, and so far from exhausting the subject, they have only indicated a much wider field for future operations.

The law of decrease of temperature under ordinary circumstances, both with a clear and cloudy sky, when the sun is above the horizon, in the months of summer, I think is pretty well determined; but from the series of observations made in winter, we cannot say such laws hold good throughout the year: neither can we say that the laws which hold good by day will be true by night; and the general result of these differences must be that the theoretical law of refraction now used must be abandoned, and that every observatory will have to determine its own laws, independently.

From the experiments on solar radiation we may infer

that the heat rays from the sun pass through space without loss, and become effective in proportion to the density of the atmosphere or the amount of water present through which they pass, and if so, the proportion of heat received at Mercury, Venus, Jupiter, and Saturn, may be the same as that received at the Earth, if the constituents of their atmospheres be the same as that of the Earth, and greater if the density be greater, so that the effective solar heat at Jupiter and Saturn may be greater than at either the inferior planets Mercury or Venus, notwithstanding their far greater distances from the Sun.

## ACADEMY OF SCIENCES.

June 5, 1865.

M. FIZEAU presented a memoir "*On the Dilatation of the Diamond, any Crystallised Protoxide of Copper, under the influence of Heat.*" The author finds that these bodies, like water, present a maximum of density at a certain temperature. The diamond, for example, has its maximum at  $-38.8^{\circ}$ , and protoxide of copper at  $4^{\circ}$ . M. Fizeau has also determined the co-efficients of dilatation in these two bodies. These are the first two solid bodies in which the maximum of density has been satisfactorily determined, although the probability of a variation with temperature has been shown.

Physicists will read with interest a memoir by M. Sarran, "*On the Propagation and Polarisation of Light in Crystals,*" which, however, it is impossible to reproduce here.

M. Fouque sent another letter "*On the Eruption of Mount Etna,*" in which he describes the present condition of the fumeroles, which seem to have changed their character. At present, or rather on the 31st of May, the dry fumeroles could hardly be said to exist, and the acid, or chlorhydro-sulphurous, according to M. Deville, predominated. These evolve ammoniacal and metallic salts. Chloride of ammonium is freely evolved from the alkaline fumeroles, and exhibits the phenomenon of dissociation at a comparatively low temperature, the vapours being strongly alkaline. The ammonia appears to combine with carbonic acid, for the condensed vapours precipitate lime water. Sulphuretted hydrogen is in some instances evolved, and sulphur is deposited from its decomposition. Carbonic acid is but rarely observed.

M. Corenwinder presented a note "*On Flemish Manure and its Employment in Agriculture.*" Flemish manure is really dried excrement, and nothing more need be said about it.

M. Cannizzaro sent a note "*On the Amines of Benzoic Alcohol.*" Just as phenols have been considered bodies analogous to alcohols, it has been thought that aniline, toluidine, &c., were alkaloids analogous to methylamine, &c. The author has prepared the primary benzylamine,  $C_6H_5CH_2N$ , and finds it to be an altogether different body from toluidine. The former is a strongly alkaline body, soluble in water in all proportions, boiling at  $182^{\circ}$ , and rapidly absorbing carbonic acid, forming with it a crystalline compound. Primary benzylamine is prepared by adding alcoholic ammonia to chloride of benzyl, and leaving them together for some days. After this time crystals of tertiary benzylamine form, and these being separated, the residue is a mixture of hydrochlorate of ammonia and hydrochlorate of primary benzylamine. The alkaloid is obtained free by treating the solution with an excess of potash. It is separated by ether, and after the evaporation of this is rectified over caustic potash.

MM. A. Vee and Leven sent a note entitled, "*Chemical and Physiological Researches on an Alkaloid extracted from the Calabar Bean,*" which, as reported in the *Comptes Rendus*, adds nothing to what they have told us before about *ésérine*, except that the name of this alkaloid is derived from *ésère*, the native denomination of the bean.



M. Pelikan sent from St. Petersburg a note "*On a New Poison obtained from Inée or Onage*," a plant of the species Echites, Apocynaceæ. It is obtained from the seeds, paralyses the heart, and is used by the natives of Gaboon to poison arrows.

## NOTICES OF BOOKS.

*Notes for Students in Chemistry: being a Syllabus of Chemistry and Practical Chemistry.* Compiled from the Manuals of Miller, Fownes, Berzelius, Gerhardt, Gorup-Besanez, &c. By ALBERT J. BERNAYS, &c., &c. Fourth Edition, revised and corrected. London: Churchill and Sons. 1865.

THESE "Notes" are intended to be such as an intelligent student would write for himself as he listened to a course of lectures, and with which he would refresh his memory when he "crammed" for his examination. That is as much as saying that they contain the substance of what the student has been told in the fewest possible words.

There is a good deal to be said in favour of such a book as this. We have had occasion to look over a good many students' note-books, and are obliged to say that they do not, as a rule, contain what it is most important to remember. It may be urged also that the practice of writing at lecture is altogether objectionable. It withdraws the student's attention from the experiments, and when he does not write short-hand, he probably loses half the lecture in an unsuccessful attempt to write down the other half. Unfortunately, too, the notes when written are often very illegible, and many never take the trouble to decipher them.

We have sometimes thought that the best way of teaching chemistry—at all events, to medical students, who form the bulk of our chemical classes—would be to take some established manual and go straight through it, illustrating and enlarging as might be necessary, but so proceeding that the student could follow the lecturer step by step with his book. The manual would thus become the note-book of the student, and we venture to think that its contents would be well fixed in his memory. Such a course would obviously not satisfy the requirements of all classes, and certainly would not satisfy the ambition of many teachers, but would still, we believe, have its advantages both for student and lecturer.

We shall give our readers the best idea of these "Notes" by making one or two extracts; and the first we select is a paragraph which is supposed to include all the most important facts relating to oxygen:—

"Oxygen  $O = 8$  ( $\ominus = 16$ ); sp. gr. 1.1057; 100 c. i. 34.29 grains. N.B.—The weight of 100 c. c. of a gas by  $\times$  its sp. gr. by that of 100 c. i. of air = 31.0117 grains. Sp. gr. compared with H, 15.936: 1774 by Priestley. Colourless, inodorous, non-condensable gas. In admixture in air, 20.81 per cent. by volume, and 23 per cent. by weight of dry air. The most magnetic of gases; the diurnal variations of the needle referable to the effects of heat upon it. Soluble in water to the extent of 3 per cent. at 60°. Necessary to combustion, respiration, decay, and germination. Prep. From  $HgO$  and heat =  $HgO$ . From  $MnO_2$ . Thus:  $3MnO_2 + \text{heat} = Mn_3O_4 + 2O$ . From  $KO, ClO_5$  by heat =  $KCl + 6O$ . By electrolysis of water  $O$  at + pole or platinode. From  $MnO_2 + HO, SO_3 = MnO, SO_3 + HO + O$ . From  $KO, 2CrO_3 + 4(HO, SO_3) = KO, SO_3 + Cr_2O_3, 3SO_3 + 4HO + 3O$ . Allotropic conditions:

Ozone  $O$ , and antiozone  $O$ . Ozone test paper 5 of starch to 1 of KI. Ozonides,  $MnO_2, CrO_3, MnO_3, Mn_2O_7$ ."

We select the next extract from the organic division:—

"**Isomerism.**—Identity of ultimate composition, with difference of chemical properties. When the eqs. identical, isomerides said to be *metameric*; when this is not the

case, the state of condensation supposed to be different, *polymeric*.  $C_2H_2, C_4H_4, C_6H_6, C_8H_8$  are polymeric. Bodies which stand related to each other like the alcohols, or which differ only by a multiple of  $C_2H_2$ , are called *homologous*; all such, when treated with the same chemical agents, furnish others, different, yet standing in a fixed relation; *heterologous*. In homologous bodies, *compound radicles* supposed to exist at methyl  $C_2H_3$  in methylic alcohol  $(C_2H_3)O, HO$ . Compound types of Laurent and Gerhardt. Distinction between atoms and molecules; the atom the smallest particle in a compound, incapable of separate existence; the molecule, the smallest quantity of an element in a separate state, must consist of at least two atoms. As a rule, the molecules of all compound bodies capable of vaporisation furnish equal volumes."

The above extracts show very fairly the plan upon which the work has been executed; and although the deficiencies of such notes must be apparent to every one, yet it must be confessed that they may prove very useful to a student cramming for a *vivâ voce* examination.

Before the author issues another edition, we would recommend him to reconsider the organic part, much of which, we fear, can only confuse a student. Moreover, it is essential that a work of this kind should be as accurate as possible, and a passage like the following, at page 17, should be corrected:—"N.B.—*Reinsch's* test consists in the introduction of clean and pure copper gauze into the suspected arsenical solution in  $HCl$ ; As is deposited as a grey film." An examiner would probably expect the student to say that the grey film was an arsenide of copper.

*Annales de Physique et de Chimie.* April, 1865.

THIS number contains a continuation of M. Weil's paper "*On New Processes for Covering Metals with Adherent Coatings of Other Metals*," an abstract of which we have in preparation. The remainder are papers which we have already noticed.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1006. J. Isherwood, Haslingden, Lancashire, "Certain improvements in dyeing or printing upon the fabric known as sail-cloth."—Petition recorded April 8, 1865.

1310. J. Bennett, Market Street, Sheffield, "Improvements in the manufacture of iron and steel."—May 11, 1865.

1324. W. Hewitt, Brewer Street, Pimlico, "An improved composition for preventing incrustation in steam boilers."—May 12, 1865.

1435. J. Giers, Middlesborough, "Improvements in ovens or kilns for the manufacture of coke."—May 25, 1865.

1453. S. Sequelin, Devonshire Street, Bloomsbury, "Improvements in purifying animal and vegetable oils or fatty matters to be used for lubricating and other purposes."—May 27, 1865.

1467. P. A. Le Comte de Fontaine Moreau, Rue de la Fidélité, Paris, "Certain improvements in the manufacture of lime."—A communication from L. Poulet, Gouesse, France.

1469. P. Young, Manchester, "Improvements in the construction of furnaces."—May 29, 1865.

### NOTICES TO PROCEED.

221. G. Haseltine, Southampton Buildings, Chancery Lane, "A new process of manufacturing syrups and sugar from maize and other cereal grains."—A communication from F. W. Goessling, Buffalo, N. Y., U. S. A.—Petition recorded Jan. 26, 1865.

240. C. de Bergue, Strand, "Improvements in furnaces."—Jan. 27, 1865.



## CORRESPONDENCE.

*Continental Science.*

PARIS, June 10.

I CANNOT say that the hypothesis of Prout has found an advocate in the person of M. Kekulé, but some considerations on the laws of chemical proportions which he has published in *Cosmos* as a sort of reply to M. Stas would seem to indicate that M. Kekulé does not accept the refutation of M. Stas as complete. We must wait until we have the whole of M. Kekulé's considerations before we can make out exactly what his ideas on the subject are. All we can see at present is that he puts forward some curious speculations. Thus, he says we may suppose the atoms of primordial matter to be distributed in space according to certain laws of symmetry, and that regular forms of space will circumscribe a certain number of these atoms, and so by employing forms which present a simple relation we may circumscribe a number of atoms which will also present a simple relation. A regular octahedron for example, will include seven atoms, and thus we may see the relation of hydrogen to lithium. Double the axes of the octahedron and we shall circumscribe 25 atoms; the atomic weight of sodium, however, is only 23. This difficulty may be got over by allowing truncations, but this, as M. Kekulé said, opens the way to arbitrary arrangements which will not do in exact science. This paper will deserve further notice when it is completed, and I will say nothing more about it at present.

I see a simple way of engraving intended to replace wood cutting, which I will quote from *Les Mondes*. The inventor starts with a smooth plate of chalk, on which he makes his drawing with gum water or something else that will harden on the chalk. He then sets to work with a hard brush and scrubs out the soft part not drawn on, and so gets his design in relief. He subsequently hardens the plate by putting it in a bath of gelatine and then drying it.

*Case of Suspected Slow Poisoning by Zinc and Iron.*

To the Editor of the CHEMICAL NEWS.

SIR,—At Malmsbury on May 20th an adjourned inquest was held on the body of Ann Lait, wife of James Lait, horse doctor. Dr. Salter stated in evidence that he had attended Mrs. Lait from April 12th last for uterine hæmorrhage and vomiting; the former rapidly ceased, but the latter continued till two days before her death on May 6th. She complained of burning heat of the stomach, fauces, and gullet, coppery taste in the mouth, great thirst and nausea after eating and drinking, followed by vomiting after from half an hour to an hour. The husband had entirely waited upon and fed her. Dr. Salter continued to attend her till the 23rd, on which day he called, and found her coming down stairs; she vomited in his presence: this he secured in a bottle, and subsequently I received it. He had been struck with her peculiar symptoms, and on calling on the 24th he saw the husband and wife together, and then said to both that he thought it his duty to tell her "that her symptoms were those of poison, not of disease, advised her to leave home, telling her that if she did she would get well, but if she remained at home she would die, and that he should refuse a certificate in case of her death. They neither of them expressed any concern. On the 29th he gave Lait for her three powders containing oxalate of cerium; on the 5th of May he called and heard she was sleeping; on the 7th a message was left at his surgery to say she was dead, and in the evening Lait called, and said "he had called in Dr. Jeston, who had seen her on the Tuesday and Thursday before her death." Dr. Salter and Dr. Jeston had consulted together, and both refused a certificate. An inquest was held, and a post-mortem followed.

On receiving the matters I found the stomach considerably inflamed in the cardiac portion, and the surface in a strange blistered state; there was not much inflammation of the intestines. In the vomit I found traces of sulphates of zinc and iron, so I did in the contents of the lower intestines; but in the remains of food in the stomach and duodenum I found only sulphate of iron. These salts, particularly that of zinc, would produce the effects described, but if used as a means of slow poisoning they would, as far as I know, constitute the first case in which they had been resorted to for the purpose.

I am, &c. WILLIAM HERAPATH, SEN.,  
Professor of Chemistry and Toxicology.

Bristol Medical School.

*Alterations in the Densities of Minerals.*

To the Editor of the CHEMICAL NEWS.

SIR,—In reply to a letter by Mr. Church in your journal of 9th inst., allow me to state that since the publication of the letter he refers to I have not been at liberty to do more than glance over his papers. This I am sure Mr. Church will excuse, when he reflects that my laboratory and my time are at the disposal of the public. From what I have seen of them, his experiments appear to me to have been very carefully conducted; but, if I am not mistaken, were made upon isolated crystals, whilst those alluded to in my paper were made upon groups of crystals; for instance, those with the lime garnet of Vesuvius, with lumps about half an inch square, containing many hundred small crystals, and I have more than once noticed these groups to bulge out slightly during the experiment without any trace of fusion occurring.

I am, &amp;c.

T. L. PHIPSON, Ph.D., F.C.S., &amp;c.

4, The Cedars, Putney, London, S.W., June 10.

## MISCELLANEOUS.

**Pollution of Rivers.**—The Queen has been pleased to appoint Robert Rawlinson, Esq., John Thornhill Harrison, Esq., and John Thomas Way, Esq., to be her Majesty's Commissioners for the purpose of inquiring how far the present use of rivers or running waters in England for the purpose of carrying off the sewage of towns and populous places, and the refuse arising from industrial processes and manufactures, can be prevented without risk to the public health or serious injury to such processes and manufactures; and how far such sewage and refuse can be utilised or got rid of otherwise than by discharge into rivers or running waters, or rendered harmless before reaching them; and also for the purpose of inquiring into the effect on the drainage of lands and inhabited places, of obstructions to the natural flow of rivers or streams caused by mills, weirs, locks, and other navigation works, and into the best means of remedying any evils thence arising.

**The Dawlish Poison Case.**—The jury in this case, and some of the inhabitants of Dawlish, have subscribed to remunerate Dr. Herapath for his analysis and evidence.

## ANSWERS TO CORRESPONDENTS.

*Dr. Phipson.*—The number will be forwarded as directed.

*W.*—We are sorry to say we know of no substances that will answer the purpose. Consult a good dentist, and have them properly stopped.

*X. Y. Z.*—The communication has not been received.

*Received.*—Dr. G. Lunge; Dr. Herapath, F.R.S.

*Book Received.*—"On Radiation:" the Bede Lecture, delivered in the Senate House before the University of Cambridge, on Tuesday, May 16, 1865, by John Tyndall, F.R.S., &c., &c.

*Erratum.*—In Dr. Lunge's paper on "The Action of Carbon on Ammonia," p. 266, line 31, for "unstable," read "suitable."



## SCIENTIFIC AND ANALYTICAL CHEMISTRY.

*A Contribution to the Knowledge of Indium,*  
by Dr. C. WINKLER.\*

ZINC from the Freiburg mines contains, besides a small quantity of lead, a small proportion of iron, arsenic, cadmium, and 0.0448 per cent. of indium. To separate the last the zinc is dissolved in dilute sulphuric or hydrochloric acid, and boiled until the evolution of gas ceases. The metallic precipitate left, when the precaution is taken to leave a little zinc undissolved, contains all the indium, together with the lead, &c. In the case of a solution containing indium—such as chloride of zinc, from which the discoverers obtained the new metal,—the separation may be effected by means of acetate of soda. This method depends upon the disposition of the oxide of indium to form a basic salt. A little dilute sulphuric acid is first added to the solution containing indium, and carbonate of soda is then added until, after stirring, a slight cloudiness remains; acetate of soda is then added, and the mixture is boiled. In this way a basic sulphate of indium, with a little iron, and zinc oxide is precipitated.

From a hydrochloric or nitric solution of indium the separation may be effected by carbonate of baryta, which perfectly precipitates the oxide in the cold. The precipitate usually contains some iron, but no zinc oxide.

To obtain the indium pure, the precipitate containing it is dissolved in nitric acid. Most of the lead is first removed by means of sulphuric acid; sulphuretted hydrogen is then passed through the liquor until the remainder of the lead, with the arsenic, cadmium, &c., are precipitated. The excess of sulphuretted hydrogen is then got rid of by boiling, and the liquor is then oxidised by means of chlorate of potash, and precipitated by excess of ammonia. In this way a good deal of the zinc present passes into solution; a small quantity, however, remains with precipitated oxides of iron and indium. The precipitate is now dissolved in dilute acetic acid, and again precipitated by sulphuretted hydrogen. A little zinc and iron still goes down with the indium, and will after six precipitations; so for the perfect purification an additional proceeding is necessary. The mixed sulphides are dissolved in hydrochloric acid; in this solution the ferric chloride is reduced to ferrous chloride by the evolution of sulphuretted hydrogen. Carbonate of baryta is now added, and then after twelve or twenty-four hours all the indium is found in the precipitate free from all impurities but baryta.

To obtain the metal, the oxide is carefully heated in a stream of hydrogen. In consequence of the volatility, the heat at first must not be great, and the gas stream must be passed slowly. After the reduction the metal will be found in small silver-looking buttons, which can be fused together under cyanide of potassium.

In colour, indium resembles platinum, but when beaten out it is whiter than lead. It marks paper strongly. It does not appear to lose its lustre in the air. Heated to bright redness, it burns with a violet blue flame, oxide being deposited on the sides of vessel in the form of a yellow crust. The specific gravity of the metal when rolled out = 7.362.

Indium seems to form only one oxide,  $\text{InO}$ . This is of a straw-yellow colour; on heating it becomes reddish brown. It easily dissolves in acid. The hydrate forms

a bulky, white precipitate, completely insoluble in ammonia and fixed alkalies. All the known salts are white. The carbonate forms a bulky, white precipitate, soluble in carbonate of ammonia, but separating again when the solution is boiled; it is insoluble in carbonates of the fixed alkalies. The phosphate is white and bulky; the oxalate is a crystalline precipitate. The sulphate forms indistinct crystals. The nitrate easily crystallises from an acid solution in clusters of needles. The sulphide is precipitated from an acetic solution by sulphuretted hydrogen. Strong acids do not prevent the precipitation, but they do interfere with the precipitation by sulphide of ammonium. The bright yellow precipitate dissolves on being heated with the precipitant, but deposits again on cooling of a somewhat whiter colour.

The author determined the atomic weight in two ways, but the results were not concordant. At present it may be received provisionally at 35.918 if  $\text{O} = 8$ ; or, 44.89 if  $\text{O} = 100$ .

*On the Crystallisation of Supersaturated Saline Solutions, and the Normal Presence of Sulphate of Soda in the Air,† by M. D. GERNEZ.*

THE crystallisation of supersaturated saline solutions is one of the phenomena which has most taxed the ingenuity of chemists to explain; the uncertain circumstances under which it is produced, the variety of causes which appear to determine or prevent it, and the hypotheses put forward have all contributed to increase the importance of this subject.

Gay-Lussac has shown that a solution of sulphate of soda will remain at the ordinary temperature without crystallising, even when it contains several times the weight of the salt which it dissolves at this same temperature, but that it forms into a mass when a crystal of sulphate of soda or certain substances previously exposed to the air is thrown into it, or when the liquid is abruptly placed in contact with the air. Many chemists (Lœwel, Selmi, Goskinski, &c.) have varied and extended Gay-Lussac's experiments; they have brought to bear on the explanation of this phenomenon sometimes water vapour, sometimes atmospheric air, or an unknown substance, or glass vessels in a particular state, or finally a catalytic force. I believe I have shown that the crystallisation of a supersaturated solution of sulphate of soda is effected by contact with a fragment, efflorescent or not, of sulphate of soda, of ten equivalents of water. This appears to me to be the result of a number of experiments of which I can here indicate only the most important.

**I. The Crystallisation of the Supersaturated Solution of Sulphate of Soda is Determined by the Fall of a Solid Body.**—We know that supersaturated solutions exposed to the air in a laboratory always end by forming into a mass. By varying the experiments I have ascertained the conditions necessary for the crystallisation. It is always produced in matrasses or flasks, if the dust in the air will by falling vertically encounter the surface of the liquid. I found that in the same place the crystallisation is much more rapid where the surface directly in contact with the air is largest, or where the air has easiest access; it is very slow where the orifice is narrow, in which case it always begins at one point, whence it extends in all directions in the form of radiated needles, and if, for instance, this takes place in a balloon with a straight neck, this point is invariably in the horizontal projection of the orifice.

\* Journ. für Prakt. Chemie, bd. 94, p. 1.

† Comptes Rendus, lx., 833.



By inclining the neck of the balloon or matrass containing the liquid while still hot, or by leaving in the usual position a retort filled with the liquid, no crystallisation takes place. It would, then, seem necessary that the corpuscles of the air should be able to reach the surface of the liquid in their vertical fall.

Several experiments, especially Lœwel's, would have led to the opinion that crystallisation is due to the presence of a solid body in the air, had not other, and apparently contradictory, experiments been made. Thus air which has traversed cotton or starch no longer determines crystallisation. I have found that all causes which arrest the movement of the solid bodies in suspension in the air produce the same effect. To ascertain this I merely repeated with supersaturated solutions the experiments made by M. Pasteur with putrescible liquids; among others, the experiment with balloons with sinuous necks.

Finally, hardly perceptible dust deposited on any body put in contact with a supersaturated solution always determines its solidification. It is the same with a thick layer of dust.

**II. The Solid Body Determining the Crystallisation is Soluble in Water.**—In a second series of experiments I found:—1. That the bodies determining the crystallisation of the supersaturated liquid lose their property when washed in ordinary water and dried, when cooled in flasks having a layer of sulphuric acid at the bottom. In the same way, dust slowly dried after being washed becomes perfectly inactive.

2. I passed into a supersaturated solution, which had remained intact, more than 1500 litres of air washed in distilled water, and, to use the least possible quantity of water, I passed the air through a series of inclined glass tubes, in each of which a drop of water uplifted by the bubble of air rose the length of the tube, diminishing in volume, and forming again in the lower part of the tube, thus serving an indefinite number of times.

3. A layer of oil poured on a solution of sulphate of soda preserves it from contact with the air and prevents its crystallising. In place of oil I employ a layer of water, when no crystallisation is produced by plunging a rod into the solution; at least, if this is done very rapidly and there is no thick coating of deposited matter on the rod, in which case should a morsel fall into the solution and not be completely dissolved, the solution will be crystallised before the rod has touched the supersaturated solution.

**III. The Solid Body Determining the Crystallisation loses its Property under the Influence of Heat.**—I verified this fact, which has long been established.

**IV. The Air which Determines Crystallisation contains Sulphate of Soda.**—I collected the few drops of water which had washed the air in the inclined tubes in experiment section II., and which contained the soluble matters of more than 1500 litres of air; they gave, with chloride of barium, a precipitate of sulphate of baryta; one drop of liquid gave, with the spectroscope, the soda ray with remarkable intensity.

Dust deposited even out of the laboratory, treated by distilled water, gave a lixivium presenting the same reactions, and contained considerable quantities of soda and of a soluble sulphate.

In short, the crystallisation of the supersaturated solution of sulphate of soda is determined by the contact of a solid body soluble in water, alterable under the influence of heat, giving with chloride of barium a precipitate of

sulphate of baryta, and containing soda; these are exactly the characteristics of ordinary sulphate of soda, which would then determine the crystallisation of its supersaturated solutions.

But does no other substance possess this property? To clear up this synthetic side of the question, I tried the action of a great many substances; among 220 I found 39 possessing this property. Of these, 18 were insoluble; I washed them in distilled water, and left them on filters shielded from the dusts in the air; when, after a few days, they were dry, I found them without action on the solution which they previously crystallised. Moreover, the lixivium gave, with chloride of barium, a precipitate of sulphate of baryta, and contained soda. The 21 soluble substances I purified by recrystallisation with or without the addition of chloride of barium. Not one of them preserved its action on the supersaturated solution. These results lead me to believe that sulphate of soda is the only substance which acts on the supersaturated solution.

Let us now consider the action of the air in Gay-Lussac's experiment with a tube, as it is ordinarily made. If the conclusion at which I have arrived be correct, it is necessary that a particle of sulphate of soda should penetrate with the air into the tube, and so determine the crystallisation. Now it seems difficult to admit that in the limited volume of air entering into the tube there should always be a particle of sulphate of soda, but this experiment succeeds, at the most, once in six times, when the precaution is taken of washing the fine end of the tube, and the pincers which serve to break it and to keep it at a distance. If it is generally most successful in the lecture room, it is because the current of air takes with it particles of sulphate of soda which have been thrown from the tube during the boiling of the liquid, and which have become attached to the outer surface, and there crystallised. However, this experiment is of little use in resolving the question at issue, as it brings into contact with the solution only a very small volume of air. It is better to pass air very rapidly (one litre per minute) into a supersaturated solution; then, while in the laboratory, a quarter of a litre is sufficient to determine crystallisation; in the open country sixty and even eighty litres are often required. This result, obtained by avoiding all the causes which might accidentally introduce sulphate of soda, makes the existence of sulphate of soda in the air more and more probable.

There is, moreover, nothing extraordinary in the presence of this substance in the air, when we remember that sulphurous acid and sulphuretted hydrogen, produced in the air, are readily transformed into sulphuric acid, and that sea-salt, procured from sea-water, gives, with this acid, sulphate of soda.

Sulphate of soda is not the only substance which can give supersaturated solutions; acetate and carbonate of soda, sulphate of magnesia, &c., have the same property. I am now engaged in studying them, and intend soon to lay the results before the Academy, and hope to be able to deduce from them an analytical process applicable to substances suitable for supersaturation, by which their presence, even in infinitesimally small quantities, may be ascertained. All the dusts which I have assayed, and which contain crystallised sulphate of soda, have been actionless on the acetate; this salt being in fact very rarely present in the air.

I had the honour of assisting M. Pasteur in his experiments, at the Museum of Natural History, relative to generations called spontaneous; there I first thought of

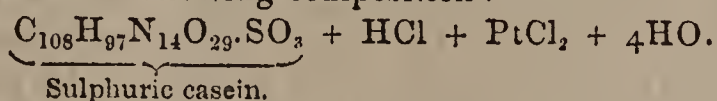


studying supersaturated solutions; their crystallisation being, as I believe I have proved, attributable to the action of particles of sulphate of soda held in suspension in the air, or deposited on the surface of bodies, there will doubtless be great similarity either in the mode of experimenting, or in the results, between my work and that of M. Pasteur relative to the inferior germs of organisation.

*Casein of Milk and its Affinities,\* by MM. E. MILLON and A. COMMAILLE.*

IN a previous communication† we indicated the regularly constituted combinations formed by casein of milk with various acids; we now purpose giving several fresh facts showing the particular direction of this affinity of casein for certain acids, and establishing, moreover, the composition of free casein, as well as the organic identity of soluble casein of milk with insoluble casein.

By treating sulphuric casein by a large excess of hydrochloric acid, we obtain a solution which is precipitated by bichloride of platinum, and the precipitate possesses the following composition:—

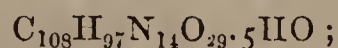


Thus sulphuric casein acts as a new chemical unit, as does casein proper; and, like many salifiable organic substances, it may be displaced from its acid combinations by other acids; in this way phosphoric casein gives sulphuric casein when treated by sulphuric acid diluted with its volume of water. But sulphuric and phosphoric acids may be found simultaneously associated with casein, and this is a striking fact when we consider how frequently sulphur and phosphorus are found together in albuminoid matters.

The combinations of casein with acetic, hydriodic, perchloric, and hydrosulphocyanic acids are all decomposed by water; not one of them, however, is so easily destroyed as acetic casein, which we used to isolate casein. Having precipitated the diluted milk by acetic acid, we washed the coagulum with water, alcohol, and ether; we dissolved it in a very weak sodic ley, reprecipitated it by acetic acid, again washed it as before, and evaporated the ether, which softened the coagulum, in the open air, or in a vacuum. We obtained in this way a light milk-white powder, the combustion of which left only a few thousandths of ash.

This powder, except the traces of ash, was pure casein, insoluble in alcohol and in ether, and very slightly soluble in water. It contained 5 equivalents of water, which it lost progressively and in definite proportions, according to the temperature to which it was submitted; thus, up to 115° it abandoned 2.21 per cent., or 3 equivalents, and up to 150°, 3.71 or 5 equivalents.

Its formula is—



that is to say, a double amide of tyrosine and leucine. So much for the composition of soluble casein of milk.

Insoluble casein has the same elementary composition, but it differs from soluble casein in its state of hydration—containing, in fact, only 3 equivalents of water. We have ourselves no doubt as to the identity of the organic group forming the nucleus of the two caseins of milk. Now, taking into consideration the influence exercised on the elementary analysis of casein, by different degrees of hydration, by the annexment more or

less complete of one or more acids, by the incorporation of various mineral or organic substances, and in very variable proportions; by taking into consideration all the disturbing influences in the estimation of casein, it will not be difficult to account for some divergence in the numbers given by several eminent chemists.

*On the Supposed Nature of Air prior to the Discovery of Oxygen, by GEORGE F. RODWELL, F.C.S.*

(Continued from page 163.)

**XII. Rise of Scientific Societies.**—In the preceding paper we have considered the labours of the Accademia del Cimento in connexion with the subject under discussion, we have now to speak of two institutions which, unlike the Italian Academy, have endured to our time, and have year by year extended their influence on the progress of the Baconian philosophy, until they have become the very centres from which its greatest results emanate—the Royal Society and the Academie des Sciences.

A few years after the death of Bacon, some of the more ardent of the followers of the “new philosophy” agreed to meet weekly at each other’s rooms for the trial of experiments, and for the discussion of subjects connected with experimental science; when the number of members of this infant society had somewhat increased, the meetings were held at the “Bull’s Head” in Cheapside, and subsequently at Gresham College, but the latter was converted into a garrison during the Commonwealth, and the meetings were discontinued till 1660, when they were resumed at the College. The Society now received large accessions to its numbers, a journal book was commenced, and rules were drawn up relative to the election of officers and the admission of fellows. On December 5, 1660, it was notified to the members that Charles II. had received information of the establishment of the Society, and that he approved of its design, and desired to promote its welfare. In 1662 a charter was granted to the Society, rendering it a corporate body, under the title of “the Royal Society for improving natural knowledge.” “Nullius in Verba” was chosen as the motto of the Society, and it may fitly be taken as the motto of the Baconian philosophy.

We have previously mentioned that Baptista Porta called one of his scientific works “Natural Magic” to distinguish it from contemporary writings on similar subjects, in which unusual physical effects were attributed to supernatural causes; now it was for a like reason that the Royal Society was defined as an institution “for improving natural knowledge.” It was founded at a time when much of the superstition of the Middle Ages still prevailed, when it was no uncommon thing to burn those suspected of witchcraft, to cast horoscopes, to seek for hidden treasure with divining rods, to practise many of the old Chaldean mysteries. The Society was to ignore all this; it was to look to natural causes for the explanation of new or hitherto unexplained phenomena, and to prove the fallacy of those superstitions which Bacon had spoken of as “mere levities that have little in them of certainty and solidity, and may be plainly confuted by physical reasons.”\* The influence of the Society in this direction was considerable, for we find a manifest lessening of superstition soon after its establishment.

Among the early Fellows of the Society were Ward, Wallis, Sir Robert Moray, Bishop Wilkins, and Robert Boyle; the latter laboured most indefatigably for the

\* *Comptes Rendus*, lx., 859.

† *Ibid*, lx., 118.

\* “Advancement of Learning,” book 3, chap 4.



good of the Society, indeed it may be considered as in a great measure due to his influence that it obtained a permanent footing. At the early meetings of the Society, the subjects discussed related chiefly to the Copernican theory, the spots of the sun, the Torricellian experiment, and the improvement of telescopes; experiments were made to determine the length of time that a candle continued to burn in a cubic foot of (a) common air, (b) rarefied air, and (c) condensed air; thin glass bubbles filled with air at the ordinary pressure were caused to swim in condensed air, and experiments were made on the increase of weight of some metals during calcination. It could not, however, be expected that the superstitious element so prevalent at this period would be entirely excluded from the discussions of the Society, especially when it numbered among its fellows such men as Sir Kenelm Digby and Sir Gilbert Talbot; nor was it at once excluded. Thus on June 26, 1661, we read that "Dr. Ent, Dr. Clarke, Dr. Goddard, and Dr. Whistler were appointed curators of the proposition made by Sir G. Talbot to torment a man presently with the sympathetical powder." July 31.—Mr. Croune exhibited before the Society a jar full of the powder of the bodies of vipers, and another full of the powder of the hearts and livers of vipers. On September 4 Sir Kenelm Digby read an account of "a petrified city and its inhabitants." Even the divining rods were thought worthy of examination by these early philosophers; July 10 we read,—"The fresh hazell sticks were produced, wherewith the divining experiment was tried, and found faulty."

At this period but little was known of foreign countries, and travellers were wont to grossly exaggerate the wonders they had seen; and more than this, often to state the most glaring impossibilities—for instance, that diamonds grew in the mines in which they were found, that there existed a river of pure balsam, that in certain countries the natives whistled so loud as to be heard at a distance of five miles, and such like absurdities; we remember to have seen in the "Mundus Subterraneus" of Athanasius Kircher (a man who had travelled much) a detailed account, accompanied by an engraving, of an encounter with a dragon. At an early period of its existence the Royal Society sent a number of questions to residents in foreign countries, with a view of ascertaining to what extent the assertions of travellers might be relied upon, and further for the purposes of scientific inquiry. In 1661 a number of questions were sent to a resident in Teneriffe; they were proposed by Lord Brouncker and Robert Boyle, and many of them were obviously for the purpose of ascertaining the difference between the air on the summit of a lofty mountain and that at its base. The recipient of the letter was desired, among other things, to try the Torricellian experiment at the top and bottom of the mountain, and to note the exact difference in the height of the mercury column; to carry up partially inflated bladders, and to observe to what extent they altered in bulk at various elevations; to weigh a bottle of air at the top and bottom of the mountain; to observe whether birds loaded in such a way that they can just fly at the bottom of the mountain, are able to fly at its summit; to ascertain if there is any moisture in the air at the summit of the mountain, and if a siphon will act there readily.

The first number of the *Philosophical Transactions* was published on March 1, 1665, and from that date to the present the publication has been continued uninterruptedly. The early volumes contain a very miscellaneous

collection of subject-matter; scientific articles were by no means alone admitted—sometimes we find two of the most diverse subjects treated of in the same communication; thus in the number for December, 1667, there is an "Extract of a letter written by Mr. Sam. Colepress to the Publisher, containing an account of some Magnetical Experiments; and also of an excellent liquor made of Cyder-apples and Mulberries." Astronomical papers occur rather frequently; medical papers less so; articles on pure physics are by no means common; the reviews of recently published books are of great interest and of frequent occurrence. We will briefly consider the various papers of importance connected with our subject which occur in the *Philosophical Transactions*.

1665. No paper relative to the air.

1666. Under the title of "*A New Statical Baroscope*," Boyle describes an apparatus for showing changes in the weight of the air, which he considers preferable in many respects to a mercurial barometer. At one extremity of the beam of a balance capable of turning with  $\frac{1}{30}$ th of a grain he suspended a sealed glass sphere full of air, about the size of a large orange; it was exactly counterpoised by a lead weight placed on the opposite extremity of the beam; minute movements of the beam were made apparent by an index which pointed to an accurately divided arc; the position of the sphere of course varied with changes in the density of the air, an alteration in which represented by a rise or fall of one-eighth of an inch in the mercurial barometer was clearly indicated by the statical baroscope.—Dr. Beal gives a number of barometrical observations, and states that he never found the mercury column higher than  $30\frac{1}{4}$  inches, nor the extreme change to exceed  $2\frac{7}{8}$ ths inch. Dr. Wallis, during a great number of observations, did not observe the mercury higher than 30 inches or lower than 28; he found it rise in foggy and sunshiny weather, and fall in wet and windy weather. Boyle, in giving directions as to how barometers should be observed, urges the necessity of ascertaining the exact elevation above the level of the sea of two localities in which separate barometrical observations intended for after comparison are being made—a point of great importance, which up to that time had been overlooked. In detailing the "General Heads for the Natural History of a Country," Boyle writes as follows:—"Concerning the air, may be observed its temperature, as to the first four qualities and the measures of them; its weight, clearness, refractive power; its subtilty or grossness; its abounding with or wanting salts; its variations according to the season of the year, and the times of the day; what durations the several kinds of weather usually have, what meteors it mostly produces, and in what order they are generated, &c."

1667. Some experiments are mentioned by Dr. Beal relative to the growing of seeds in vacuo. Lettuce seed was planted in earth, part of which was placed in the open air, and part in vacuo; in eight days the seed which was planted in the open air had produced plants one and a-half inch high, while that in vacuo had not sprouted; on admitting air to the receiver, the included seed produced plants from two to three inches high in a week's time. In a short notice of "*An Experiment of Sigr. Fracassati upon Blood Grown Cold*," we find mention of an important fact hitherto unobserved—or at least unrecorded. The dark colour of venous blood had for a long period been believed to be due to an admixture of the "melancholy humour" (one of the four supposed constituents of blood); Fracassati observed, however, that when dark-coloured blood was exposed to the air



its upper layer became bright red, while the blood beneath remained dark coloured; from whence he infers that the dark colour of blood is not due to the "melancholy humour," but to the want of an admixture of air, since the presence of air at once converts it into red blood.

1668. In the *Transactions* for this year we have an interesting paper by Boyle, entitled "*New experiments concerning the relation between Light and Air in shining wood and fish*," in which we find, among others, the following experiments:—A piece of luminous rotten wood was placed under the air-pump receiver, on exhausting it ceased to emit light, but when air was admitted the luminosity returned. In order to see if the light could be perfectly extinguished like that of a red hot coal placed in a vacuum, pieces of luminous wood and fish were left in an exhausted receiver for from twenty-four to forty-eight hours on admitting air, the bodies immediately regained their luminosity. A piece of luminous wood was placed in a vessel into which air was compressed, but the wood did not shine brighter than before. A piece of luminous fish was placed in a bottle of water, which was included within a receiver, and the air exhausted, but no effect was produced. In order to ascertain whether "the cold fire" of shining wood could be maintained by a very small quantity of air, a piece of wood was hermetically sealed in a glass tube; it retained its luminosity perfectly for a length of time.

1669. No paper relative to the air.

1670. Boyle contributes an interesting paper entitled "*New pneumatical experiments about respiration*." We have previously mentioned Boyle's experiments on respiration which he described in the first "*Physico-mechanical experiments touching the air*." In this paper we have a continuation and enlargement of his former experiments; those here described were principally made in 1662 and 1663. As ducks are able to remain for an appreciable time under water, Boyle conceived that they would form good subjects for experiment, accordingly he enclosed one in the air-pump receiver, and exhausted, whereupon the duck was brought to the point of death in a few minutes. A viper was alive at the end of two and a-half hours, during which it had been kept in an exhausted receiver; a second was enclosed in a very small receiver, which was well exhausted; at the end of an hour and a half it was to all appearance dead, but on admitting air twenty-three hours afterwards, it proved to be alive. A large frog placed in a receiver was observed to swell out considerably when exhaustion was commenced, in a short time it appeared to be dead; at the end of three hours air was admitted to the receiver, and the inflated frog immediately shrank up to a very small size, still to all appearance dead; nevertheless, on being placed overnight on grass in the open air, it was found to be alive and well the next morning. In order to ascertain whether animals "that had been lately accustomed to live either without any or without a full respiration would not be more difficultly or slowly killed by the want of air, than others which had been used to a free respiration," Boyle placed a kitten (born the previous day) in a small receiver, and exhausted, at the end of six minutes it appeared perfectly dead, but on removal to the open air it recovered after a while; a second kitten which was left in vacuo for seven minutes did not recover when air was admitted. An oyster was kept in vacuo for twenty-four hours, and remained alive; a crawfish also lived in vacuo; a leech which was kept in an exhausted receiver was found to be alive and well at the end of five days. The heart of an eel just taken out was

placed on a tin plate in an exhausted receiver, it continued to beat for an hour. A gudgeon remained alive for some time in vacuo. From the numberless bubbles of air which ascend from water placed in vacuo, Boyle puts it as a query "whether in common water there may not be concealed air enough to be of use to such cold animals as fishes; and whether it may be separable from the water that strains through their gills." In order to see if the volume of air is altered by animals breathing in it until it is incapable of supporting life, birds and mice were placed in tubes together with a mercury gauge, the tubes were then hermetically sealed, and put aside until the animals and birds were suffocated; the gauge indicated no change in the volume of the air within the tubes. As it would be of service in our comprehension of the minuteness of a particle of air, if it could be proved that very minute insects breathe, Boyle placed a number of mites in a small receiver, and exhausted; on examining them with a lens, they were observed in a short time to become perfectly motionless, and to continue so, but on the admission of air they manifested considerable liveliness; whence he considers that it may be taken as proved that they breathe.

1671. The only paper of interest in connexion with our subject in this year's *Transactions* is a short one on "*The Compression of Air by water*," in which the following experiment is detailed:—A glass bottle of a quart capacity was fitted with a valve opening inwards; it was sunk in the sea mouth downwards to a depth of thirty-three feet; on drawing it up, it was found to be half full of water, proving that the weight of a column of water of thirty-three feet high had compressed the air in the bottle to half its volume, as might have been predicted from the previous experiments of Boyle and Hooke on the compression of air by a column of mercury.

1672. When a tube five or six feet long, closed at one end, is filled with mercury perfectly free from air, and then inverted into mercury, after the manner of making the Torricellian experiment, the mercury in the tube will frequently be found to remain suspended at a much greater elevation than that at which the pressure of the atmosphere would cause it to remain; but if the tube be shaken, or if a slight blow be given to it, the column at once falls to its usual height of 30 inches above the stagnant mercury. In order to account for this, Huygens propounded a most unphilosophical theory (contained in a letter to the *Journal des Savans*, and reprinted in this year's *Phil. Trans.*), which affirmed that, in addition to the pressure of the air, there is a second pressure of a more subtle matter than air, which is able to penetrate glass, water, and mercury, and that it is due to this additional pressure that the mercury column under the above circumstances remains suspended above 29 inches. Although this hypothetical matter could penetrate glass, Huygens conceived that so long as the mercury was absolutely in contact with the end of the glass tube, so that there was no free space in the tube, it could not be readily pressed upon, but upon shaking or jarring the tube the mercury was separated from its close contact therewith, and the subtle matter immediately rushed in and caused the descent of the mercury. He conceived further that the presence of this additional pressure was proved by two experiments: the one, that a siphon will act in vacuo; the other, that two perfectly plane plates placed in contact will not separate in vacuo any more than in air, although a weight may be attached to them.

The Académie des Sciences was founded in 1666, mainly by the exertions of Colbert, Carcavy, Auzout, Huygens, and Roberval. During the century it pub-



lished ten volumes of proceedings, known as the "Anciens Memoires de l'Académie." In 1699 the Academy underwent an entire reorganisation, and from that time to the present the memoirs have appeared more frequently.

There are only two papers of interest in connection with our subject which appeared before 1673 (to which date we have taken our notices of the *Philosophical Transactions*). The first is "On the Augmentation of Weight of Certain Matters during Calcination." In this the author, M. du Clos, gives the following explanation of the cause of the increase of weight observed. He conceives, "Que l'air qui coule incessamment vers les endroits, où il y a du feu, laisse surces matieres embrasées pleine de souffres terrestre, des particules sulphurées plus volatiles, qui s'unissent avec eux, s'y fixent, et forment ces filamens dont nous avons parlé, qui sont apparemment toute augmentation du poids." The other paper details some vacuum experiments, almost all of which had been previously made. No mention is made of Boyle's air-pump, and Otto Guericke's form of the instrument was apparently employed. In order to ascertain whether heat passed as readily through a vacuous space as through air, some butter was placed in a receiver, and a hot iron held as near to it as practicable outside the receiver. The butter did not melt so readily when the receiver was exhausted as when it was full of air, probably, according to the author (whose name is not mentioned), because air, in virtue of the grossness (*grossièreté*) which it possesses, is more capable of conveying heat from the hot side of the receiver to the butter than the very thin and subtle matter which remains in the receiver after the air has been pumped out.

## TECHNICAL CHEMISTRY.

### *Preparation of Aniline Green.\**

ONE part of fuchsine is treated with a mixture of one and a half parts of sulphuric acid and half a part water, and the whole is gradually heated to dissolve the fuchsine; after the solution has cooled four parts of aldehyde (prepared as below) are added. Heat is then carefully applied to the mixture, and as soon as it becomes of a bright blue colour the heat is withdrawn. The colour is best observed by letting a drop or two fall into water acidulated with sulphuric acid. The heat must be continued until no violet shade is seen. When the change to blue is perfect boiling water and hyposulphite of soda are added simultaneously, the mixture is stirred and thrown on a cloth filter. The residue is washed with quite boiling water until it is all dissolved. The filtrate is then allowed to stand for twenty-four hours, and is then again filtered. The mass now remaining on the filter is the green colour, which is dried at 30° to 38°, and then powdered.

### *Manufacture of Aldehyde for the Preparation of Aniline Green.†*

THREE hundred and fifty parts of sulphuric acid are first diluted with 150 parts of water, and when the mixture has cooled 820 parts of alcohol are gradually added. The mixture is placed in a vessel of glass or earthenware fitted with a tube and stopcock. In a tubulated retort 300 parts of bichromate of potash in small pieces and 150 parts of water, are placed. The tubulus of the retort is fitted with a funnel, and heat

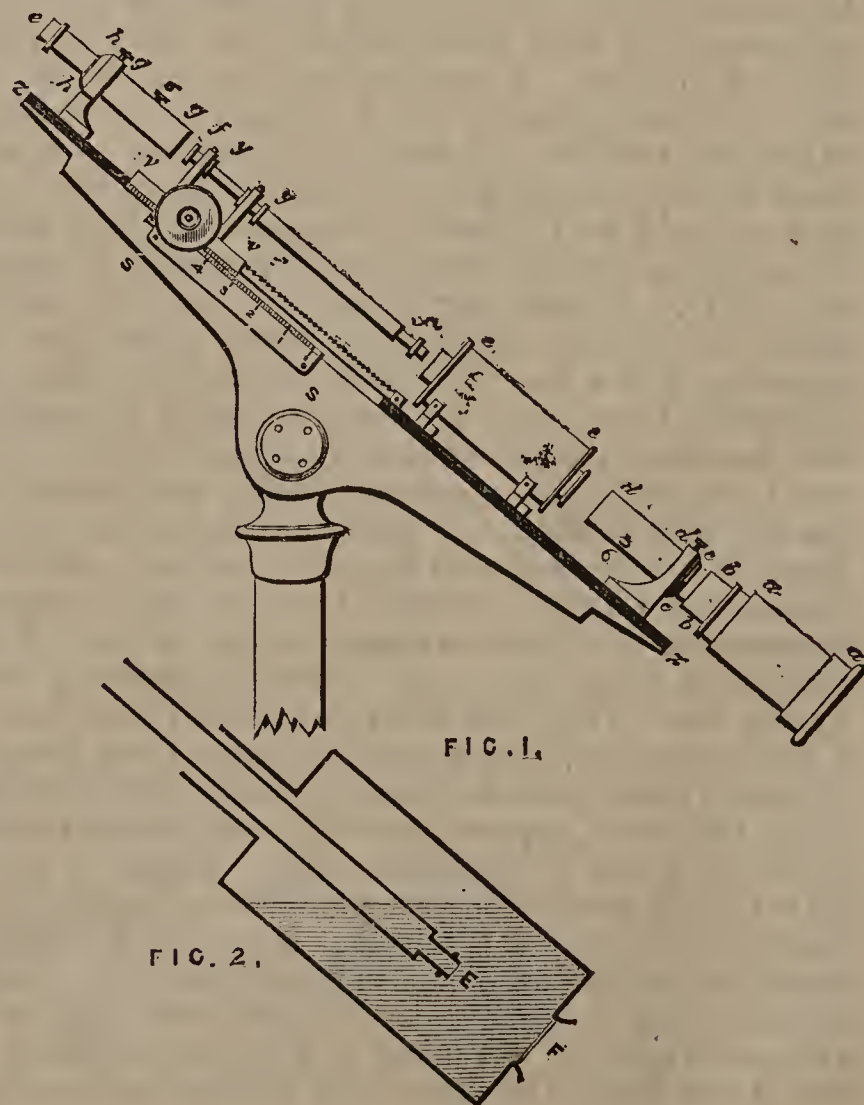
being applied, the mixture of sulphuric acid and alcohol is allowed to run gradually into the retort. The aldehyde distils over, and may be collected by the ordinary appliances. It requires one or two rectifications.

THE  
DUBLIN INTERNATIONAL EXHIBITION.  
By CHAS. R. C. TICHBORNE, F.C.S., F.R.G.S.I., &c.  
(Specially Reported for the CHEMICAL NEWS.)  
(Continued from page 283.)

MESSRS. BELL, BROTHERS, of Newcastle-upon-Tyne, exhibit some aluminium, but as this metal is only used in this instance for decorative purposes we shall not dilate upon the beautiful statuettes and groups which are exhibited by the above firm. From these specimens no doubt can be entertained of its applicability to these purposes. Although some doubt was formerly expressed, its preservative properties have been since well proved, and if sufficient purity is attained the metal is practically untarnishable.

**Scientific Instruments.**—Mr. Spencer, of Dublin, in a neat case containing some very good chemical and other instruments, shows one of Professor Jellett's saccharometers. As this form of saccharometer is little known on the other side, and as it is a matter of some importance, I may make no apology for dwelling at some length upon the subject now in hand. The original description will be found in the *Transactions* of the Royal Irish Academy.

Professor Jellett says that his saccharometer is capable of giving more accurate results than those obtained by means of the instrument of Soleil. He adds, that as far as he can judge, both from his own experiments and the report of others who had used it, the errors to which even an accurate observer would be liable, in attempting to estimate the strength of a saccharine solution, could not be reckoned as less than half a grain per cubic inch for a single observation. The following diagram represents Professor Jellett's instrument:—



\* Chem. Central Blatt, 1865, p. 368.

† Ibid., 1865, p. 383.



*a a* is a short tube containing two large lenses serving to condense the light of a lamp which is placed as nearly as possible in the principal focus of the lower lens. *b b*, *c c* is a short tube carrying at one extremity a lens *c c*, and at the other extremity a diaphragm *b b*, pierced at its centre by a small hole *O*, which is situated in the principal focus of the lens *c c*, and also when the instrument is adjusted, in the principal focus of the upper lens *a*. By this arrangement a beam of light is obtained emerging from *c c*, sensibly parallel to the axis of the tubes. This beam is polarised by being transmitted through a Nicols' prism contained in the tube *d d*; *e e* is a vessel pierced at the lower end by a circular hole, which is closed with plate glass. This vessel contains a fluid possessing a rotative power opposite to that of the fluid under examination. This latter fluid is contained in the tube *f f*, which rests on the two upright pieces *y y*. These pieces are attached to the transverse pieces *v v*, which carries a Vernier, whose dimensions correspond to those of the scale *s s*, which is attached to the bar *z z*, which carries all the parts of the instrument. The transverse piece *v v* is capable of sliding along *z z*, this motion being produced by a chain attached at both ends to *z z*, and passing round a spindle with a milled head attached to *v v*. By these means a motion can be given to the tube *f f* parallel to its own axis, and by a simple arrangement the zero of the Vernier is made to coincide with the zero of the scale when the extremity *f* of the tube is in contact with the piece of glass covering the lower aperture in the vessel *e e*. It is plain, then, that the numbers read on the scale, which is graduated so as to be read to 0.001 inch, will denote the length of the column of fluid *E F* (Fig. 2) interposed between the bottom of the vessel and the bottom of the tube; *g g* is an analysing prism, constructed according to Professor Jellett's plan\*; *h h* is a lens, and *l* a diaphragm with a small hole, at which the eye of the observer is placed.

The polarising and analysing prisms are fixed in their places by small screws  $\sigma, \sigma'$ , each passing through a transverse slit in the outer tube, so that when partly unscrewed they allow the prisms to turn through a small angle round the axes of the tube. In using the instrument, the polarising prism may be set in any position, the analysing prism being then carefully adjusted so that the tints seen in the two halves of the circular spectrum may, when there is no fluid interposed, be exactly equal. Suppose, now, that the object is to ascertain the strength of a given solution of cane sugar. In this case the fluid to be used in the vessel *E E* may be French oil of turpentine. A certain quantity, the amount of which depends on the strength of the solution to be observed, having been poured into the vessel, the tube *f f* is then filled with a solution of sugar whose strength is accurately known. The tube is now replaced in the upright pieces, and the zero of the Vernier made to coincide accurately with the zero of the scale. The milled head is now turned so as to draw back the tube until the tints on the two parts of the circular image seen through *L* become equal; the number on the scale corresponding to the zero of the Vernier is then noted. Let this reading be *R*, and let *S* be the strength of the solution.

This solution is then removed from the tube, which is then to be filled with the solution whose strength is required. The same process having been gone through, let the new reading be *R'*; then the strength required is given by the equation:—

$$S' = \frac{R'}{R} \cdot S.$$

If the experiment be carefully conducted, and if there be no error in the strength of the standard solution, the error in the measurement made as above described, ought not to exceed 0.02 grs. per cubic inch for a single experiment, and if the mean of a number of experiments be taken the error will of course be less.

It is not desirable to use a very strong solution of the substances to be examined. No general rule can be given for determining the strength of this solution which it is desirable to use. If the law of Biot, that the amount of rotation produced by the same substance in the planes of polarisation of the different simple rays are proportional to the squares of the corresponding indices, be strictly true, then the more nearly these indices are in the same proportion for the fluid under examination and the compensating fluid, the stronger may be the solution used. If the fluid under examination be a saccharine solution, and the compensating fluid French oil of turpentine, a solution containing in each cubic inch thirty grains of sugar may be used without inconvenience.

The importance of such an instrument to the practical chemist is at present hardly appreciated. The writer had some experience in connexion with the verification of turpentines some short time since, which was effected by the aid of Professor Jellett's instrument. French turpentine and American turpentine have opposite rotatory powers, whilst the turpentine substitutes, or products of American mineral oils, are inert; not only can, therefore, a qualitative investigation be instituted, but a quantitative one may be performed. Professor Jellett's investigations in connexion with the distribution of acids and bases in solution and upon the alkaloids (part of them are still unpublished), are some of the most curious that we have come across for some time. We must confess that in spite of precedent we should prefer a better name than a saccharometer for this instrument. Professor Jellett evidently sees this, for he remarks that the name is derived from one important use to which it may be applied. "This, however, is only one of its applications, and there are many others at least as important. It may generally be defined to be an instrument by which the ratio of the rotatory power of any transparent fluid to that of a standard fluid may be accurately determined."

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, June 15.

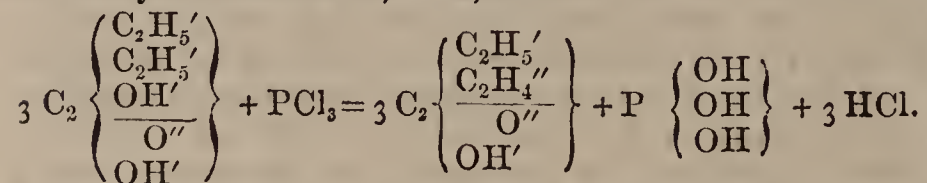
Prof. W. A. MILLER, M.D., F.R.S., President, in the Chair. THE minutes of the previous meeting were read and confirmed. Mr. William Marriott, Huddersfield, and Mr. Charles Umney, 40, Aldersgate-street, London, were proposed as candidates for election into the Society. For the second time were read the names of Mr. Frederic Row, Colchester, and Mr. James Parkinson, Royal School of Mines. Mr. George Bacon Sweeting, Surgeon, King's Lynn, Norfolk, was balloted for and duly elected a Fellow of the Society.

Dr. FRANKLAND gave an interesting account of the researches lately undertaken by Mr. Duppa and himself, "On the Transformation of the Lactic into the Acrylic Series of Acids." By the action of perchloride of phosphorus upon the ethers of the lactic group, the authors had succeeded in effecting a variety of transformations, resulting in the production of acids belonging to the acrylic series. These changes were effected by the replacement of two atoms of hydrogen in the original body by an

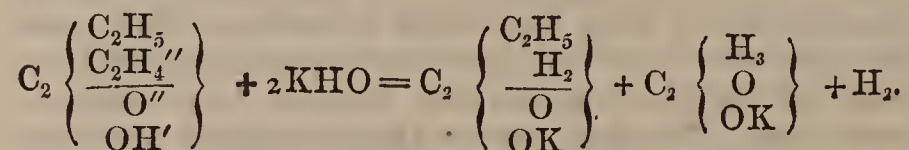
\* *Proceedings of the Royal Irish Academy*, vol. ii., p. 348.



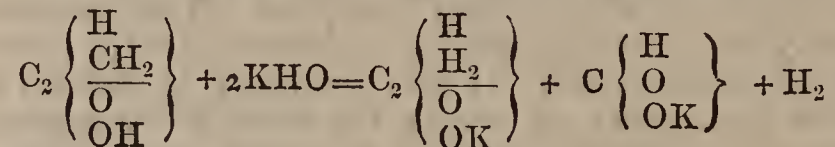
olefine, and differed, therefore, from the simpler cases of transformation formerly described, in which the oxygen of oxalic acid, for instance, was replaced by one atom of hydrogen and one of an organic radical (as in lactic acid), or by two distinct organic radicals. The principle of Dr. Frankland's investigation is well seen in the following example, wherein leucic (diethyloxalic) acid is converted into ethyl-crotonic acid, thus,—



Instead, however, of employing the acid itself in these reactions, it was found more advantageous to operate upon their respective ethers. The product of the above reaction was a liquid of specific gravity '9203, and having an odour partaking both of the character of mushrooms and oil of peppermint. Its boiling point was 165° C., and observed vapour density 4.83, the number demanded by theory for the two-volume vapour being 4.90. The copper, silver, and other metallic salts of ethyl-crotonic acid were prepared and examined. The physical properties both of the acid and its compounds were not identical with those exhibited by the substances obtained by the old mode of production; so that the new body was isomeric with the ordinary ethyl-crotonic acid. The action of phosphoric anhydride upon leucic ether was described as giving the same results as the terchloride of phosphorus. By the action of hydrate of potassium, ethyl-crotonic acid furnished a mixture of butyrate and acetate of potassium, with liberation of hydrogen gas, thus—



Acrylic acid itself submitted to the same treatment furnished likewise an acetate as the invariable product, with simultaneous generation of an alkaline formiate, thus—

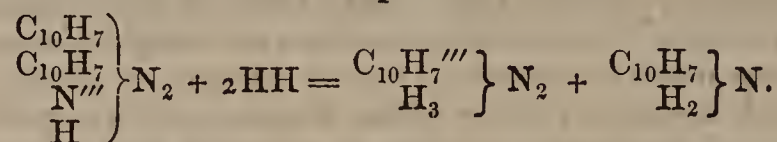


It was interesting to know that when ethyl-methyl-oxalic ether was treated with the chloride of phosphorus the ethyl radical was attacked in preference to the methyl, and the product was therefore methyl-crotonic acid; but when lactic ether was submitted to the same process it did not yield results homologous with the foregoing, but furnished the chloropropionic acid of Ulrich and Würtz. In this case the hydroxyle was replaced by chlorine, and not by an organic radical. A comparative view of the constitution of the several members (eleven) of the acrylic group, and of the three series of acids under discussion, was shown by the aid of large diagrams, and Dr. Frankland concluded with some general remarks upon the numerous isomerisms brought to light during the progress of these researches, and suggested the possibility of establishing by future investigation the replacement of three atoms of hydrogen by one of a triatomic radical.

In reply to the President and Dr. Gladstone, the lecturer said that the physical study of the series of isomeric bodies just now described was as yet far from complete; and in answer to Mr. G. C. Foster's objection to the scheme of nomenclature, Dr. Frankland admitted some inconsistencies, and said it would have been better to start from lactic instead of oxalic acid; but these appellations had been adopted by Würtz, and, now that the ground had been taken from under their feet, it was difficult to set about framing an entirely new system; but the authors had made some progress in this direction when their revolutionary

proposals were threatened by the almost unpronounceable character of the names; thus, methyl-acrylic acid should be called methyl-methylene-acrylic acid, and ethyl-crotonic acid might be described under the non-euphonious name of et-etheno-crylic acid.

Mr. W. H. PERKIN then read a paper "*On the Action of Nascent Hydrogen on Azodinaphthyl-diamine.*" The author digested an alcoholic solution of the base with metallic tin and hydrochloric acid until the violet colour gave place to a pale buff tint. The solution being evaporated, and the tin removed from solution by sulphuretted hydrogen, a mixed product was obtained, which was prone to oxidation. Upon addition of hydrochloric acid, crystals were deposited which consisted of the mixed hydrochlorates of two bases, viz., naphthylamine and naphthyl-diamine; their formation was thus explained:—



Azodinaphthyl-diamine. Naphthyl-diamine. Naphthylamine.

By the addition of an alkali to the hydrochlorate or other salt of the new diamine the base is liberated in the form of beautiful glistening scales; but the colour of the solution is quickly changed to a dull green by absorbing oxygen from the air (shown by experiment). By distillation in hydrogen the pure base was obtained in the form of a pale yellow oil, which solidified on cooling into a nearly white crystalline mass. Its boiling-point is above the range of the mercurial thermometer. It is soluble in alcohol, ether, and benzole. The sulphate and hydrochlorate were obtained in a state of purity and analysed; the nitrate and oxalate were likewise prepared. Mr. Perkin here showed the magnificent green colouration which ferricyanide of potassium imparted to solutions of naphthyl-diamine, and the subsequent effect of ammonia in changing this tint to violet—reactions which served to distinguish this base from naphthylene-diamine. The author then described the steps of the process by which he had succeeded in isolating pyridine from the mother liquors of the naphthyl-hydrochlorates, and remarked that its occurrence was interesting from the circumstance that the base had never before been obtained excepting as a product of destructive distillation. The formula of pyridine being exactly one-half that of naphthyl-diamine suggested the possibility of splitting up the last-named substance; but up to the present time the author had not succeeded in obtaining pyridine by such a process.

The PRESIDENT remarked that the last statement of the author reminded him of Dr. Anderson's results in the production of picoline.

The SECRETARY announced the titles of three papers received from Professor Church—1. "*Note on a Cornish Mineral of the Atacamite Group;*" 2. "*On a New Ferric Hydrate from Cornwall;*" 3. "*Analyses of some Ancient Bronzes found in Great Britain.*" Mr. Robert Warrington, jun., had likewise promised to send a communication, but it had not yet arrived.

The PRESIDENT said that, as time did not permit of reading these papers, they would be in due course printed in the Journal; and, after passing a vote of thanks to the respective authors, the meeting of the Society was adjourned until after the recess.

## ACADEMY OF SCIENCES.

June 12, 1865.

M. H. St. C. DEVILLE communicated a memoir, entitled, "*Critical Researches on the Constitution of the Compounds of Niobium.*" The author considers he has proved that the hypochloride of niobium of Rose is really an oxy-chloride,—a conclusion Marignac had arrived at before, Rose's  $\text{Nb}_2\text{Cl}_3$  ( $\text{Nb} = 48.3$ ) being, according to Marignac,  $\text{Nb}_2\text{O}_3\text{Cl}_3$  ( $\text{Nb} = 47$ ). M. Deville believes that all the



seemingly extraordinary properties of niobium may be brought under the common laws.

M. Meunier read a continuation of his memoir "*On the Solution of some Metallic Oxides in Fused Caustic Alkalies*," the first part of which we have recently printed (see ante, p. 242). He has now analysed the violet compound formed when binoxide of mercury is dissolved in fused potash, and found it to be composed of binoxide of mercury 81.9; potash determined by difference 18.1. The formula  $\text{KO}_2\text{HgO}$  requires binoxide 82.1, potash 17.9. When protoxide of bismuth is dissolved in fused potash, the solution becomes of a deep red colour. Being treated with water, a deep brown powder is left, which does not contain a trace of potash, and which the author regards as bismuthate of oxide of bismuth, or  $\text{Bi}_2\text{O}_4$ . M. Meunier has also studied the behaviour of the earthy oxides with fused alkalies. All dissolve easily in potash, but less easily in soda. 100 parts of potash will dissolve about 50 parts of lime or magnesia, and 30 of strontia or baryta. These solutions of the earthy oxides appear to have a strong affinity for oxygen, and possess the power of bringing metals to their highest state of oxidation. Silver, iron, copper, and lead dissolve in the earthy alkaline solutions; so do tin, antimony, and even platinum. Gold does not dissolve. Some of the solutions part with the oxygen again as they cool, and spirt like fused silver. The author believes that alkaline peroxides are formed in the reactions. We shall translate this paper as we did the former.

M. Persoz added another chapter to his memoir "*On the Molecular State of Bodies*." This one relates to the capacity of saturation. The capacity of saturation in oxides is proportional to the quantity of oxygen they contain. Acids with very different proportions of oxygen will unite with equal quantities of bases. This latter fact is owing to the acids containing one or more equivalents of oxygen in a particular state—*polar oxygen*; and M. Persoz believes that the saturating power of an acid is proportional to the number of equivalents of polar oxygen which it contains. Mono- bi- and tri-basic acids contain 1, 2, and 3 equivalents of such oxygen. The existence of this polar oxygen, the author says, helps us to explain a great number of chemical reactions.

The study of the laws of the composition of salts has led M. Persoz to establish the following propositions:—

1. The molecule of inorganic acids, with few exceptions, contains an uneven number of equivalents of oxygen.
2. Organic acids in which we find an uneven number of oxygen equivalents are all either monobasic or tribasic. Those which contain an even number are either bibasic or quadribasic.
3. In saline compounds the sum of the oxygen equivalents in acid and base is always an *even* number.
4. The oxygen, directly or indirectly, impresses on saline compounds by condensing them, a volume having a simple relation with its own.
5. When two bodies combine it is always in simple relations of volume.

MM. Maréchal and Tessié du Motay presented a memoir "*On Vitrified Photographs*." This does not admit of condensation, so we shall give it at length in an early number.

M. Corenwinder communicated "*An Analysis of a Tropical Seaweed*," *Sargassum buxifolium*, the only thing remarkable in which is the amount of phosphoric acid found. Although, says the author, the phosphoric acid in sea water is in too small amount for the chemist to detect, marine plants find sufficient for their wants.

M. Carlevaris sent a note "*On a New Mode of Producing a Fixed Light, Constant and White*." The author burns carbon, upon which he places a piece of chloride of magnesium, in the oxyhydrogen flame; or he makes cakes of carbonate of magnesia, and uses them in place of lime cylinders with the same flame.

## NOTICES OF BOOKS.

*The Phenomena of Radiation as Exemplifying the Wisdom and Beneficence of God.* By GEORGE WARINGTON, F.C.S., (Actonian Prize Essay). London: Skeffington. 1865.

As chemists we have happily no call to discuss the value of "Evidences of Design" and "Exemplifications of Beneficence," either in convincing the atheist or in supporting the believer. It is a more agreeable duty on the present occasion to recognise in this work great scientific knowledge, rare literary skill, and an admirable moderation of tone. The book will be read with pleasure by all who take it up, and we believe it will prove the most popular of the Actonian Essays. To the student it will bring the great truths of science, set forth in warmer language than would be appropriate in a class book; while for the general and religiously-minded reader it offers the double attraction of sound scientific teaching with the inculcation of a reverential faith.

The nature of the work unfortunately almost precludes the possibility of making an extract which will do both the author and his subject justice; but we select two.

The first answers the question—What is radiant force? "Our conception, then, of the exact nature of radiant force must be somewhat as follows:—It is occasioned by the exceedingly free and rapid vibrations of the surface particles of the radiating body, which vibrations are communicated to the particles of an all-pervading æther, and carried along by their means with extraordinary velocity. The slowest and longest of these vibrations produce the sensation of heat, which gradually rises in intensity as they increase in speed, until it reaches its maximum somewhat below the red end of the spectrum. Then the heating power again diminishes, and shortly afterwards, as the speed of the vibrations increases, the sensation of dull red light is produced. By a still greater increase of speed the heating power vanishes altogether, the red brightens, passes into orange, and at last yellow, where is the maximum of luminosity. The speed rising still higher, the yellow passes into green, and the green into blue, where chemical potency begins to show itself, increasing rapidly as the blue passes into violet, and attaining its maximum somewhat beyond that end of the spectrum. After this it, too, diminishes, and the vibrations probably cease altogether.

"The conversion of heat, light, and actinism (as the chemical power of light is called) into each other is thus seen to be simply a change in the *rate* of undulation, produced by the particles of the absorbent matter being caused to vibrate at a different rate from that of the communicating æther; much in the same way, probably, as musical sounds are capable of producing in absorbent bodies not only their own notes, their own vibrations, but also their *harmonics*, vibrations bearing a simple relation to their own. The conversion of these forces into ordinary motion, and their production therefrom, are also seen to be readily explicable, as a mere change of the mode or form in which motion acts."

After thus describing the nature and the laws of Radiation, the author proceeds to consider it as the Distributor of Light and Heat, as the Mainspring of Meteorology and Climate, as the Physical Cause of Vegetable and Animal Life, and lastly, in its Relations to Geology and Astronomy, and in this last section we find a remarkable and suggestive passage:—

"One more lesson there is, which this grand science has still to teach, a most appropriate conclusion of the whole. Among all these glorious worlds, lit up and energised, as we have every reason to believe they are, by radiant force emitted by their central orbs, have we accounted for *all* that force accomplishes? Take our own system as a sample. As already noted, but  $\frac{1}{2,500,000,000}$ th part of solar radiation is expended on the earth. A little also goes to other planets,



more, no doubt, than to the earth; but even then what a minute fraction of the whole must this amount to. What becomes of all the rest? We cannot tell. Scattered into space on every hand, to all appearance it does nothing. Even that little employed upon the planets is ultimately cast forth again in like manner into space. The same takes place in all those million other systems with the radiation they enjoy. Whither goes this wondrous store of force? There is no power in space to change it, much less destroy it altogether; the very science of astronomy depends for its materials on the fact, that radiation is *not* changed or stayed upon its course in passing through it. Yet there seems no object in the Universe for which this force exists. To conclude it therefore useless, waste, would be to ignore the whole array of facts that science sets before us, to put our lack of knowledge of its purpose for knowledge of its lack; besides, still leaving the main difficulty unremoved—if it be useless, still, *what becomes of it?*''

We have no space for more, and must conclude by recommending all our readers to peruse and enjoy this essay for themselves.

*Bulletin Mensuel de la Société Chimique de Paris, May, 1865.*

We have here the first instalment of an account by M. Joulin of the "*Potashes and Sodas of Stassfurth*." These extraordinary mineral deposits have not yet been adequately described in English, almost the only notice they have received being contained in Dr. Hofmann's Exhibition Report (p. 47). In these deposits upon a very deep bed of rock salt rests a layer of Kieserite (chiefly sulphate of magnesia), and upon this again a bed of Carnallite, a mineral composed of the chlorides of potassium and magnesium. Here, as M. Joulin remarks, we have the salts lying in the order of their solubility, which goes to prove that they were deposited from a slowly evaporated solution. Some considerations lead to the supposition that the evaporation took place at a temperature lower than 50° C., the principle of which is that no sulphate of soda is formed, a salt that must have been formed from the reaction of sulphate of magnesia on chloride of sodium at a temperature but little above 50°. These deposits are now worked with great vigour, and in the year 1864, 115,327,000 kilogrammes of the potash compound were extracted from the mines and delivered to the manufacturers. The price of the rough material has, since March this year, been 1 fr. 62 c. per 100 kilos.

An important paper was contributed to the Prussian Society by M. A. Semenoff, "*On the Law of Volumes in Chemical Double Decompositions*." The author enunciates the following laws:—(1.) In decompositions with bodies in the state of gas or vapour, the sum of the volumes of the molecules of the reacting bodies is always equal to the sum of the volumes occupied by the molecules of the bodies formed in the reaction; and (2) in double decompositions between liquids and solids, the molecular volumes taken at the usual temperature before and after the reaction, remains unaltered, and, just as in the case of gases and vapours, the sum of the molecular volumes of reacting bodies is equal to the sum of the molecular volume of the bodies formed. The author gives numerous illustrations of these laws, and draws the following conclusions:—

1. The final result of all decompositions is a simple juxtaposition of atoms without sensible condensation. Changes of volume can only take place at the moment of reaction.

2. The production or absorption of heat in double decompositions can only be regarded as equivalent to internal molecular work, which is not employed to keep the atoms at a distance after the reaction.

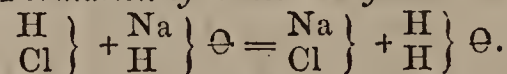
3. We can calculate with sufficient nearness the theoretic specific weight of a solid or liquid body, in the same way as we can find the theoretic density of a gas.

4. The law enunciated may be of great utility in the

study of water of crystallisation, and the phenomena that supersaturated solutions present.

It may be as well to give an example, and we select one illustrating the second proposition above:—

*Formation of Chloride of Sodium.*



$$28.745 + 18.779 = 29.074 + 18.$$

$$\text{Total: } 47.944 = \text{Total: } 47.04.$$

Chloride of sodium  $\begin{array}{c} \text{Na} \\ \text{Cl} \end{array} \} = 58.468$  (molecular weight.)

Specific weight =  $2.078$  Karsten =  $28.137$  } (mole.  
" =  $2.011$  Joule & Playfair =  $29.074$  } vol.)

The other papers communicated to the Paris Chemical Society we have noticed already in our reports of the Academy of Sciences, and we find nothing new in the abstracts of foreign papers.

*The Simplicity of the Creation; or, the Astronomical Monument of the Blessed Virgin; a New Theory of the Solar System, Thunderstorms, Waterspouts, Aurora Borealis, &c., and the Tides.* Dedicated to the Mother of God. By WILLIAM ADOLPH. London: Burns and Lambert. 1864.

THERE are many reasons why we cannot notice this book at length; but we have no objection to say that it is evidently the work of a man who has read largely and thought much; and if we have found it impossible to agree with his scientific conclusions—opposed, as we believe, to all demonstrated truth when the subject is open to demonstration, and in general to probabilities when the matter is only open to speculation—we may still admire the piety and earnestness of the writer.

*The Declaration of Students of the Natural and Physical Sciences.* London: Simpkin and Marshall. 1865.

THE list of signatures to this now celebrated declaration has been published, and for the small charge of twopence any one can possess this Directory of Orthodoxy. That is all we can say about it.

*Chemisches Central Blatt, Nos. 23 and 24.*

THE first of these two numbers is for the most part filled with abstracts from English sources, and the second is mainly occupied by papers we have already noticed. But we find some short account of the "*Preparation of Aniline Green, and the Manufacture of Aldehyde*," which we transfer to our pages. Short notices of a "*New Process of Making Mosaic Gold*," and "*On a Mode of Coating Copper with Antimony*," will be found among our "*Miscellaneous*" paragraphs.

## NOTICES OF PATENTS.

### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

477. W. E. Gedge, Strand, "A chemical combustible substance and apparatus to which it is applicable."—A communication from F. Stoker, Faubourg St. Martin, Paris.—Feb. 20, 1865.

1064. W. Beardmore, Parkhead, Lanarkshire, N.B., "Improvements in the arrangement of furnaces used for puddling and re-heating iron, the generation of steam and other similar purposes."—April 13, 1865.

1352. W. Wright, Mostyn, Flintshire, "Improvements in the treatment of the waste liquors obtained after heating burnt ores of copper, such improvements having for their object the production or extraction of cobalt and nickel." May 16, 1865.



1424. J. A. Coffee, Gracechurch Street, London, "Improvements in the retorts used in the manufacture of gas and in other distillations, which improvements are adaptable to evaporating vessels."

1428. R. Maxwell, Glasgow, N.B., "Improvements in applying coal-tar colours to cotton and linen."

1438. H. Gibbs, Hampstead Road, "Improvements in the manufacture of artificial fuel, applicable chiefly to the kindling of fires."

1443. M. Henry, Fleet Street, "Improvements in treating fibrous materials and textile fabrics, and in producing soap." A communication from L. Pasquier, and A. J. Dumout, Boulevard St. Martin, Paris.—May 25, 1865.

1448. R. Canham, Clerkenwell, "Improvements in cupola and other blast furnaces."

1450. C. B. Spaeth, Philpot Lane, London, "A new preparation for subduing and extinguishing fire." A communication from G. Leisler, Leipsig, Saxony.—May 26, 1865.

1456. R. A. Brooman, Fleet Street, "A new method of manufacturing oil from fatty matters or the residuum arising from the distillation of fatty matters, the manufacture of stearic acid soap, and purification of oils." A communication from P. R. Beaumont, Paris.

1460. L. Moser, Southampton, "Improvements in the manufacture of steel, and in furnaces used in such manufacture." A communication from J. Paulis, Liège, Belgium, May 27, 1865.

1480. J. Hibell, Nechells, near Birmingham, "Improvements in annealing pots and saucers, for annealing iron and steel wire, sheet metal, and other articles."

1486. R. H. Collyer, Brompton, Middlesex, "Improvements in the process and apparatus for the treatment of materials for the manufacture of paper and other purposes."—May 30, 1865.

1498. T. Summerson, Darlington, "Improvements in foundry cupolas."—May 31, 1865.

1507. W. Clark, Chancery Lane, "Improvements in the means of carburetting or treating aëriiform fluids for lighting and heating purposes, and in apparatus for the same."—A communication from H. A. G. du Vergier, Boulevard St. Martin, Paris.—June 1, 1865.

1541. W. E. Newton, Chancery Lane, "An improved photo-electrotyping process."—A communication from W. A. Leggo, and G. E. Desberats, Quebec, Lower Canada.

1545. C. H. Wansbrough, Shrewton, Wiltshire, "Improvements in the treatment of condensing pans employed in the condensation of milk."—A communication from S. Percy, New York, U.S.A.—June 5, 1865.

1547. D. Barker, Ceylon Street, Battersea Park, "Improvements in the manufacture of artificial fuel."

1549. R. A. Brooman, Fleet Street, "Improvements in the construction of reservoirs for containing and storing petroleum and other oils."—A communication from P. Jacovenco, Bucharest, Wallachia.—June 6, 1865.

#### NOTICES TO PROCEED.

246. G. Haseltine, Southampton Buildings, Chancery Lane, "An improved process of manufacturing syrups and sugar from maize starch and other cereal grain starch."—A communication from F. W. Goessling, Buffalo, N.Y., U.S.A.—Jan. 28, 1865.

261. W. Teall, Wakefield, Yorkshire, and A. Naylor, Bradford, Yorkshire, "Improvements in means or apparatus for extracting or expressing oil or grease from the greasy waste of fibrous substances, or other substances containing oil or grease."—Jan. 30, 1865.

270. W. H. Cox, Bermondsey, Surrey, "Improvements in tanning hides and skins, and in apparatus employed therein."—Jan. 31, 1865.

310. J. A. Phillips, Kensington, "Improvements in the purification of lead to be employed for the manufacture of white lead, red lead, and litharge."

313. E. Hottin, Rue de la Fidélité, Paris, "Certain

improvements in rendering unflammable cotton, silk, and other textile fabrics."—Feb. 4, 1865.

447. W. E. Newton, Chancery Lane, "Improvements in apparatus for distilling petroleum and other volatile liquids and for making gas."—A communication from G. H. S. Dufflus, New York, U.S.A.—Feb. 16, 1865.

469. J. Graham, Warrington, Lancashire, "Improvements in treating products obtained when coating iron with zinc."—Feb. 18, 1865.

1287. W. Jackson, Glasgow, N.B., "An improved method of mixing gases and vapour, and in the machinery or apparatus connected therewith."—May 9, 1865.

297. T. Routledge, Sunderland, "Improvements in treating spent or used leys resulting from the preparation of fibrous substances used in the manufacture of paper stock."—Petition recorded Feb. 2, 1865.

301. B. L. Mosely, Norfolk Street, Sheffield, "A new or improved tooth powder."—Feb. 3, 1865.

307. F. Row, Colchester, "Improvements in the manufacture of citric and tartaric acids, and in the manufacture and treatment of citrate and tartrate of lime and analogous basic compounds, and in apparatus employed therefor."

319. R. M. Allowly, Strand, "Improvements in treating or manufacturing peat for fuel, and in apparatus for the same."—Feb. 4, 1865.

391. W. Crookes, F.R.S., Wine Office Court, Fleet Street, "Improvements in extracting and separating gold and silver from their ores or matrices."—Feb. 11, 1865.

893. W. M. Fuller, Wolverhampton, "An improved process for reducing or preparing waste animal matters for the purpose of employing the same in the preparation of manures or fertilising compounds."—March 29, 1865.

1319. H. Ransord, Brompton, Middlesex, "Improvements in treating rice and other grain for the manufacture of starch, also to prepare them for use as food, and for other purposes."—May 12, 1865.

#### CORRESPONDENCE.

##### Continental Science.

PARIS, June 20.

You will probably have seen before now M. E. Kopp's admirable translation of your report of the farewell banquet to Dr. Hofmann in the *Moniteur Scientifique*, but I cannot help alluding to the introductory remarks, in which M. Kopp shows a gratifying appreciation of the position of foreign professors in England. "It," the banquet, he says, "shows that the savants of England, far from being led by mean jealousies (as is too often the case on the Continent), find a satisfaction and a pleasure in recognising and proclaiming the merit of their illustrious confrère, and that his old pupils retain a lively gratitude and sincere affection for the eminent professor who guided them in their early labours." This is perfectly true, and will be read with satisfaction both by Dr. Hofmann's entertainers and Dr. Hofmann himself.

In imitation of that entertainment, the *Moniteur* suggests a banquet to M. Chevreul, who will enter his eightieth year on the 1st of next September, and for fifty-five years, it is said, has stood the most faithful champion of French science. Some difficulties—jealousies,—however, will, I fear, have to be got over before this banquet takes place.

I find nothing in the report of the last meeting of the Société d'Encouragement worthy of notice, but the mention of an apparatus, contrived by M. Storms, which allows plants to water themselves when they stand in need of it. No description of this desirable apparatus is given, I am sorry to say.

I see the mention of a new combustible, invented by a gentleman who very appropriately bears the name of Stoker. It appears to be very pure charcoal, finely ground and made into a paste with starch. The paste is moulded



into cakes or balls of different sizes, and then dried. When perfectly dry these may be lighted with a lucifer match, and will continue to burn steadily, like German tinder, without giving flame or smoke. The combustible is intended for heating urns, chafferettes, &c.

M. Dufour, of Lausanne, has made some experiments to ascertain whether other gases behaved like atmospheric air in the phenomenon of ebullition under different pressures. He employed hydrogen, carbonic acid, and coal gas, and found that when water saturated with either of these gases was heated to boiling in an atmosphere of the same gas, the phenomenon proceeded exactly as if the liquid were in the presence of air. The ebullition showed nothing unusual, and the temperature at which it took place was only raised one or two degrees. He concludes that the difficulty gases have in quitting liquids holding them in solution comes of a purely physical adhesion, and not of a chemical affinity.

Let us hope that the day is soon coming when that fatal disease, pulmonary consumption, will altogether disappear, since the remedies are now numerous enough. M. Fuster, who is a professor in the Faculty of Sciences at Montpellier—a school of renown in the annals of medicine—has discovered a specific. It is a very simple remedy—merely pills of raw beef and mutton, washed down by a not unpleasant form of grog—100 grammes of alcohol, 250 grammes of water, and 60 grammes of orange flower-water. There can be no objection to a little sugar in this latter mixture, I imagine.

#### The Dawlish Poisoning Case.

To the Editor of the CHEMICAL NEWS.

SIR,—There having been a great deal said, in your late numbers, respecting the above mysterious case, in which the arsenic is said not to have caused the death of Mrs. Williams, but that strychnia was the cause, I have (for the information of those interested) extracted the following from the *Atlas* for October, 1843:—"On the Different Effects of Arsenic on Different Persons.—In October, 1843, Mr. Wakley, M.P., held an inquest on the body of a person suspected to have been poisoned by arsenic. The coroner observed how extraordinary it was that arsenic should have an entirely different action on two different persons. Two persons shall have taken the same quantity of this poison. On the one it shall act just like an anodyne, soporifically, first producing somnolency, and finally death without pain or struggle. In the other, after it had been taken into the stomach, it shall produce violent vomiting and extreme agony, which shall continue until death takes place in the midst of excruciating torture. In the first instance, after death, dissecting will show no internal ulceration. In the second, it will produce marked appearances of the most violent inflammatory action. He (the coroner) was constantly struck with surprise at seeing in cases where the precise cause of death was surely known, the post-mortem appearances disagreeing *in toto* from what they ought to be, considering the cause of death."

I think, Sir, the symptoms of this second case are nearly identical with those of Mrs. Williams, so that the arsenic found in the stomach might have produced all her symptoms had strychnia not been present.

I am, &c. JEREMIAS.

Red Lion Street, Clerkenwell, June 20.

#### MISCELLANEOUS.

**Royal Institution.**—The following are the arrangements for the ensuing week:—Wednesday, June 28, at 4 o'clock, Thursday, June 29, at 4 o'clock, and Friday, June 30, at 4 o'clock, M. Jules Simon "On the Physical and Moral Condition of Workmen in France." (In French.)

**Mode of Coating Copper with Antimony.**—Dullo dissolves two ounces of butter of antimony in a quart of spirits of wine, and adds hydrochloric acid until the solution is clear. Into this solution he puts the object to be coated, previously well cleaned and polished. In the course of three-quarters of an hour a solid and brilliant covering of antimony is deposited. Cast iron may be coated with copper by placing it in an alkaline solution of chloride of copper, and then covered with antimony by the above process.—*Chem. Cent. Blatt.*, 1865, p. 368.

**Phenic Vinegar.**—Dr. Quesneville gives the following recipe for an *antipestilential*. Take acetic acid (5°), 900 grammes; camphor in powder, 5 grammes; crystallised phenic acid, 100 grammes. This combination of three antiputrescents is said to be extremely useful, and for hygienic purposes far superior to *vinegar of the four thieves*, as toilet vinegar was once called. It has been used a good deal on board ship to keep the cabins of sick persons sweet.—*Moniteur Scientifique*, 1865, p. 515.

**Preparation of Bisulphide of Tin.**—Kletinsky dissolves four parts of salt of tin in twenty parts of water previously mixed with two parts of strong hydrochloric, or one part of strong sulphuric acid. This solution is heated nearly to boiling, and then saturated with sulphurous acid gas. The following reaction takes place:— $3\text{SnCl} + 2\text{HO} + \text{SO}_2 + \text{HO} + 5\text{SO}_2 = \text{SnS}_2 + 2(\text{SnO}_2, 2\text{SO}_2) + 3\text{HCl}$ . The yellow sulphide of tin is collected on a filter, washed and dried, and the filtrate may be distilled to recover the hydrochloric acid, sulphate of tin remaining in the retort. If the dried sulphide of tin is sublimed at a red heat, access of air being prevented, beautiful mosaic gold is obtained in large shining scales, and spangles of a brilliancy that is never seen with the old way of making the gold.—*Chem. Cent. Blatt*, 1865, p. 368.

**Preparation of Gold Purple for Gilding.**—Brescius states that gold may be easily obtained in this convenient form by precipitation in the cold from an alkaline solution by means of oxalic acid. He dissolves four ounces of gold in a mixture of two pounds nitric acid (sp. gr. 1.2) and one pound hydrochloric acid (sp. gr. 1.12). To this solution he adds another, made by dissolving pure potash, or, at all events, potash free from silica, in five or six parts of distilled water. After filtration, this latter solution is gradually added to the gold solution. The mixture is now diluted with eight pounds of distilled water, and then a clear and cold solution of one-third of a pound of oxalic acid is stirred in, care being taken not to rub the sides of the dish with the rod. In this way a bulky, spongy, black precipitate is obtained, which must be allowed to settle, and then be well washed and dried.—*Dingler's Polytech. Journal*, Feb., 1865, p. 217.

#### ANSWERS TO CORRESPONDENTS.

\* \* In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. X. of the CHEMICAL NEWS, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I. and II. are out of print. All the others are kept in stock. Vol. XI. commenced on January 6, 1865, and will be complete in 26 numbers.

\* \* All Editorial Communications are to be addressed to the EDITOR, and Advertisements and Business Communications to the PUBLISHER, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. Private letters for the Editor must be so marked.

Received.—Dr. Hassall.

R. S.—Dr. Letheby's lecture will be published in an early number.



SCIENTIFIC AND ANALYTICAL  
CHEMISTRY.

*The Molecular Weight of Protochloride of Mercury,*  
by M. E. ERLÉNMEYER.\*

SOME chemists attribute to protochloride of mercury the formula  $\text{HgCl}$ , others  $\text{Hg}_2\text{Cl}_2$ ; in seeking for a solution of this question the author made the following experiment:—Into a flask with a long, difficultly fusible glass neck, he introduced a tube three times the length of the neck. This tube, closed at one end, penetrated to the centre of the matrass, and was filled with mercury to the height of two inches and a quarter. Some protochloride of mercury was heated in the flask for half an hour, at a temperature high enough to make the mercury boil and the vapour condense only two inches and a quarter above the level of the liquid. After cooling, globules of mercury were observed on the outside of the tube and in the neck of the flask, and both were carefully cleaned to remove all the metallic mercury. They were then heated a second time until the flask became perfectly transparent, and no volatile product remained condensed. The apparatus was then slowly cooled, and a deposit of mercury larger than the first was found; the united metallic globules formed 0.0296 grm. Crystals were deposited at the beginning of the neck of the matrass, which were crushed in a mortar, then shaken for some time in cold water, and were found to contain bichloride of mercury.

This experiment, says the author, does not prove that the composition of chloride of mercury is  $\text{Hg}_2\text{Cl}_2$ ; the formula  $\text{HgCl}$  might with equal justice be attributed to it, for  $\text{HgCl} + \text{HgCl}$  would give  $\text{Hg} + \text{HgCl}_2$ ; the experiment does not in any way show that all the vapour which gives the protochloride of mercury is  $\text{Hg} + \text{HgCl}_2$ . Were it proved that solid protochloride is  $\text{Hg}_2\text{Cl}_2$ , it might very well be that the vapour might be composed of  $\text{HgCl} + \text{HgCl}$  and  $\text{Hg} + \text{HgCl}_2$ ; to prove that the protochloride vapour is really  $\text{Hg}_2\text{Cl}_2$ , it would be necessary to obtain half the vapour in the form of metallic mercury, and half as bichloride.†

TECHNICAL CHEMISTRY.

*Detection of the Adulteration of Essential Oils with Oil of Turpentine by the Saccharimeter,* by Dr. JULIUS MAIER, Assistant in the School of Mines, Columbia College, N. Y.

THE essential oils, especially the expensive ones, are mostly adulterated with oil of turpentine. It is often difficult to detect this adulteration, especially when the adulterated oil gives similar reactions with oil of turpentine.

With the saccharimeter it is possible not only to detect the adulteration, but even to find out the quantity of oil of turpentine mixed with the other essential oils. A large number of oils, particularly those belonging to the camphenes, the carbon of which is in the proportion

of 5 to 8 to their hydrogen, have an action on the polarised light, deviating the light either to the right or the left hand side. These optical researches have been made by Biot, Soubeiran, Capitaine, Gladstone, and Berthelot, in order to establish the constitution of the camphenes. I made some researches to detect the adulteration of the essential oil with the oil of turpentine.

For that purpose, a chemically pure oil of lemon, which I had prepared myself, was tested in a saccharimeter, the tube of which was 200 mm. long.

The deviation was  $+137^{\circ}296$  for the middle yellow ray. The oil of turpentine used for the research, prepared by myself, had a specific gravity of 0.865, and gave a deviation of  $-73^{\circ}135$ . A mixture of equal volumes of both these oils showed a deviation of  $+30^{\circ}65$ . The calculation gives a deviation of  $+32^{\circ}081$  in the following manner:—

$$\begin{aligned} \frac{1}{2} \text{ vol. oil of lemon} &= + 68^{\circ}648 \\ \frac{1}{2} \text{ vol. oil of turpentine} &= - 36^{\circ}567 \end{aligned}$$

$$1 \text{ vol. mixture} = + 32^{\circ}081$$

A mixture of 2 vol. oil of lemon with 1 vol. oil of turpentine gave a deviation of  $+65^{\circ}34$ ; from the calculation results a deviation of  $+67^{\circ}152$ , as follows:—

$$\begin{aligned} \frac{2}{3} \text{ vol. oil of lemon} &= + 91^{\circ}531 \\ \frac{1}{3} \text{ vol. oil of turpentine} &= - 24^{\circ}379 \end{aligned}$$

$$1 \text{ vol. mixture} = + 67^{\circ}152$$

I made the same researches with pure oil of juniper, which I had prepared myself, and arrived at the following results:—

The oil used for the experiment had a specific gravity of 0.858, and showed a deviation of  $-5^{\circ}970$ . The oil of turpentine employed was the same as in the above-mentioned experiment. A mixture of equal volumes of oil of juniper and oil of turpentine showed a deviation of  $-40^{\circ}84$ ; the calculation gives a deviation of  $-39^{\circ}553$ , as follows:—

$$\begin{aligned} \frac{1}{2} \text{ vol. oil of juniper} &= - 2^{\circ}985 \\ \frac{1}{2} \text{ vol. oil turpentine} &= - 36^{\circ}568 \end{aligned}$$

$$1 \text{ vol. mixture} = - 39^{\circ}553$$

From this it is proved that the quantity of the adulterating oil of turpentine can be detected through the medium of the saccharimeter. But if the essential oil is adulterated not only with oil of turpentine but also with another optically active oil, the saccharimeter test is of no value. In order to find out the quantity of the adulterating oil of turpentine from the deviation showed by the oil of turpentine, by the adulterated oil, and by the mixture, the numbers of deviation have to be brought in reference to a common distinct starting point. This starting point generally is the power of rotation—that is, the deviation of the respective oil as calculated for a tube of 100 mm. length, and a specific gravity of 1. This power of rotation, the worth of which is generally expressed by  $[\alpha]$ , is the following for:—

$$\begin{aligned} \text{Oil of turpentine } [\alpha] &= - 42^{\circ}275 \\ \text{Oil of lemon } [\alpha] &= + 80^{\circ}573 \\ \text{Oil of juniper } [\alpha] &= + 3^{\circ}479 \end{aligned}$$

The quantity of oil of turpentine employed for the adulteration is calculated as follows:—

$$\begin{aligned} a & \text{ the power of rotation of the pure oil.} \\ b & \text{ " " " " oil of turpentine.} \\ c & \text{ " " " " mixture.} \\ m & \text{ the quantity " " } \\ x & \text{ " " " " adulterating oil of turpentine.} \end{aligned}$$

\* *Annalen der Chemie und Pharmacie*, cxxxi., 124.  
† Dr. Odling (see *Journal of the Chemical Society*, ii., 211) explains the irregularity of the density of protochloride of mercury vapour by admitting that  $\text{Hg}_2\text{Cl}_2$  in the state of vapour splits up into one atom of mercury and one molecule of bichloride of mercury; he supports this opinion by the fact observed by himself, that gold leaf becomes covered with mercury in the vapour of calomel, and that bichloride is formed at the same time. M. Erlenmeyer attributes this reaction to the affinity of mercury for gold, and sees no other cause for this decomposition.



The quantity of the pure oil as contained in the mixture is  $=m-a$ , and the power of rotation of this quantity is  $=(m-x)a$ ; the power of rotation of the oil of turpentine  $=-bx$ , and the power of rotation of the whole quantity of mixture  $=mc$ ; hence results the following equation:—

$$\begin{aligned}(m-x)a-bx &= mc \\ ma-ax-bx &= mc \\ ma-mc &= ax+bx \\ \frac{m(a-c)}{a+b} &= x\end{aligned}$$

To show this calculation by an example, the power of rotation is supposed to be—

$$\begin{aligned}\text{of the pure oil of lemon} &= +80^{\circ}573 \\ \text{,, ,, ,, turpentine} &= -40^{\circ}275 \\ \text{,, mixture} &= +18^{\circ}70 \\ \text{the quantity of the mixture} &= 20 \text{ c. cm.} \\ (20-x)80^{\circ}573 - 40^{\circ}275x &= 20 \times 18^{\circ}70 \\ 7611.46 - 80^{\circ}573x - 70^{\circ}275x &= 374 \\ 1237.46 &= 122.848x \\ 10.0 &= x.\end{aligned}$$

The mixture contains equal parts of the pure oil and the adulterating oil of turpentine.

#### Optical Behaviour of Several Essential Oils.

Tested Oil.	Specific gravity.	Power of rotation.	Observer.
Oil of absinth . . . . .	0.973	+ 20° 67	Soubeiran and Capitaine.
Oil of orange blossoms, first product . . . . .	0.835	+ 127° 43	
Oil of orange blossoms, second product . . . . .	0.837	+ 125° 59	
Oil of bergamot . . . . .	0.850(?)	+ 29° 28	Biot.
Oil of bergamot, first product . . . . .	0.850	+ 49° 396	Soubeiran and Capitaine.
Oil of bergamot, last product . . . . .	0.877	- 6° 573	
Oil of caraway seed . . . . .	0.897	- 11° 7	
Oil of lemon . . . . .	0.848	+ 80° 484	Biot.
Oil of lemon . . . . .	0.852	+ 80° 573	Maier.
Oil of lemon (Grasse), first product . . . . .	0.844	+ 79° 749	Soubeiran and Capitaine.
Oil of lemon (Grasse), last product . . . . .	0.853	+ 78° 156	
Oil of lemon, rectified . . . . .	0.854	+ 80° 916	
Oil of copaiva balsam . . . . .	0.881	- 34° 18	Soubeiran and Capitaine.
Oil of copaiva balsam (Para) . . . . .	0.898	- 28° 553	
Oil of cubebs . . . . .	0.929	- 40° 159	
Oil of cubebs, free from water . . . . .	0.914	- 39° 40	Deville.
Oil of elemi . . . . .	0.852	- 90° 30	
Oil of juniper . . . . .	0.855	- 3° 521	
Oil of juniper . . . . .	0.858	- 3° 479	Soubeiran & Capitaine.
Oil of turpentine . . . . .	0.8722(?)	- 39° 950	Maier.
Oil of turpentine . . . . .	0.860	- 43° 38	Biot.
Oil of turpentine . . . . .	0.865	- 42° 25	Soubeiran & Capitaine.

Gladstone (Chem. Soc. Jour., [2], ii., 1) has given a more complete table on the power of rotation of most of the essential oils. My researches were restricted to the few above mentioned.—*American Jour. Science*, xxxix., 273.

#### Improvements in the Manufacture of Sugar.

A CORRESPONDENT writes:—"I have seen some sugar from Antigua which is the result of a new mode of boiling down. This sugar is in reality only boiled-down juice, and yet it is so dry that after being earried in paper in the hold of a ship some weeks, only a few moist spots are observable. This every one knows is possible only with very dry sugar. The colour is light grey, or better than colonial sugar from which the treacle is extracted. In other words, this is sugar manufactured without molasses or treacle being formed. Now, if we take

the amount of loss from crystallisable sugar being made into treacle at 20 per cent., this increase in the amount of sugar will at once be given to our colonies, if this method is practicable. It is equal to increasing them by nearly one-third without trouble or expense.

"We learn from Antigua papers that Mr. Alfred Fryer, of Manchester, has been making the first trial in that colony, where the firm, Messrs. Fryer, Benson, and Forster, have bought sugar estates for the express purpose of beginning the new system.

"It is well known that when the juice of the cane is boiled down the amount of uncrystallisable matter increases. The increase may be said to be 14 or 15 per cent. but an equal amount of sugar is thereby rendered uncrystallisable, so that about 30 per cent. is actually lost to the consumer.

"Mr. Fryer found that cane juice containing 2.6 per cent. of fructose or uncrystallisable sugar, after being heated in a closed vessel for an hour without air at 250° Fahr., contained 55 per cent. of fructose. Juice which contained 13.1 per cent. by boiling for an hour at 225° F. was found to have 29.5 per cent. of fructose. The temperature reached in the colonies is about 242° F.

"After the juice had been boiled down into dry sugar by Mr. Fryer, and then dissolved in the same amount of water which it had lost, it actually contained as much crystallisable sugar as before. It is believed that no fructose whatever is passed, and other experiments made by Mr. Fryer seem to confirm this. He has found that the cane-juice is not entirely free from fructose, that on the contrary from 1.3 to 13 per cent. of the sugar exists in that state; it is impossible, therefore, to obtain boiled down sugar entirely crystallisable.

"The name given to this apparatus for rapid evaporation is 'the concreter,' as the sugar is obtained in a solid hard form, in which condition it is sent over to this country to be refined.

"The amount of acidity is equal only to that in the cane juice. The colour of the dissolved concrete is superior to that of the juice left after the first crystallisation in sugar works, and the sugar beetle, we believe, does not appear.

"No wonder that the Governor of Antigua should have said to Mr. Fryer, at a large public and enthusiastic meeting, 'I believe firmly that you have opened a new era of prosperity to our colonies, and heartily wish you abundant success in the course on which you have entered.'

"It seems true, and it is wonderful, that whilst we have been complaining so long in our sugar colonies, we, and the rest of the world, should have been spoiling one-third of our sugar. Mr. Fryer estimates the increased value of the produce treated by his system to be equal to 4l. per hogshead. We need not give a description of the evaporator, which consists of very shallow vessels connected in series and the use of heated air."

#### PROCEEDINGS OF SOCIETIES.

##### ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, March 10.

"On the Eozoon and the Laurentian Rocks of Canada." By Professor A. C. RAMSAY, F.R.S.

MR. RAMSAY commenced by giving a brief account of the physical structure of part of the interior of North America, which consists of great plains and table lands lying between the ranges of the Laurentian mountains



(which run from Labrador far westward along the north shores of the St. Lawrence and Ottawa), the mountains of Gaspé and the Appalachian chain, and the gradual slopes of the Rocky mountains in the far west. The geological survey of Canada embraces great tracts of the Laurentian mountains and of the mountains of Gaspé, and all the flat country that lies south of the St. Lawrence, the Ottawa, and Lake Huron, and in these territories a vast region has been surveyed in a manner that may fairly be said not to have been surpassed on any part of the North American continent. This survey was begun in the year 1842, and before its commencement the Silurian strata of the United States having been generally correlated to those of Europe, the precise relations of the strata of Canada to both soon began to be established. Before that period very little was known by geologists about the Laurentian rocks, except that they consisted of gneiss, granite, syenite, and so-called igneous masses, and the geological age of the series was undetermined. Indeed, the gneiss of the mountains north of the St. Lawrence, and of the Appalachian chain, of Gaspé, Newfoundland, and other districts were all more or less confounded together, and supposed, as gneiss, to be probably of the same or nearly of the same age.

But in 1845 it was first proved by Sir William Logan that the Laurentian gneiss lies unconformably under the Potsdam sandstone, a rock well known to be the equivalent of the Lingula flags of Britain, or the "Primordial zone" of Barrande, then and for long after supposed to contain in its lingulæ and trilobites the earliest created forms of organic life. This, taken in connection with the discoveries of other American geologists, clearly proved the Laurentian gneiss to be of much earlier date than the greater part of the gneiss of the Green Mountains (a part of the Appalachian chain), and of Gaspé, &c., for they were shown to be the metamorphosed representatives of various members of the Silurian series, most of them younger than the Potsdam sandstone.

This was followed by the discovery of the Huronian rocks, which were proved also to be older than the Potsdam sandstone, but younger than the Laurentian gneiss; and not only so, but it was shown that the Huronian rocks, themselves metamorphic, were deposited after the metamorphism of the Laurentian strata; for they contain pebbles and boulders of the latter in such a condition, that it is plain the metamorphism of the masses from which they were derived took place long before the commencement of the Huronian epoch.

In 1863 a stratigraphical discovery, still more remarkable, was made; for it was proved that the Laurentian rocks themselves consist of two series of altered strata, the uppermost of which lies in the highest degree unconformably on the lower series; and it was again found that the Potsdam sandstone, quite unaltered, lies thoroughly unconformably on the upper Laurentian gneiss.

Besides total unconformity, there is a marked and constant distinction in the nature of the gneiss of the two series, the lower being Orthoclase-gneiss, containing potash-felspar, while the upper has been called Anorthosite-gneiss, containing lime and soda-felspar, much of which is true Labradorite; and these differences being constant, there is no difficulty in distinguishing the two series.

Both series are exceedingly contorted, and have undergone an amount of metamorphism that may almost be called extreme, unless we adopt the view that granite and its allies are the result of an amount of metamorphic action so excessive that the rocks have passed beyond the stage in which foliation still remains.

The Lower Laurentian being at present the oldest known stratified series, its base is unknown; although as it contains in some cases *water-worn stratified pebbles*, it is clear that its original unmetamorphosed materials were derived from the waste of consolidated stratified formations

of far older date. Neither are its topmost strata known, for all the other strata with which it is in contact lie unconformably upon it. Its known thickness is, notwithstanding, very great, as the following measured section of a portion of the strata will indicate. It is given in descending order:—

1	{ Orthoclase gneiss . . . . .	3400 feet.
	{ Crystalline limestone. . . . .	20 "
	{ Orthoclase gneiss . . . . .	1580 "
2	{ Crystalline limestone of Grenville, with a } thin band of gneiss and <i>Eozoon Canadense</i> }	750 "
	{ Orthoclase gneiss, with quartzite and garnets }	3500 "
3	{ Crystalline limestone, with two bands of } gneiss, with garnets and hornblende }	2500 "
	{ Orthoclase gneiss . . . . .	4000 "
4	{ Crystalline limestone of Trembling lake .	1500 "
	{ Orthoclase gneiss of Trembling mountain. }	5000 "
		22,250 "

It was in 1858 that fossils were found in the band of limestone No. 2; and at first they were considered by Sir Wm. Logan to belong, probably, to the genus of corals known as *Stromatopora*, but renewed examinations, first by Dr. Dawson, Principal of McGill College, Montreal, and afterwards by Dr. Carpenter, establish that in reality the fossils are *Foraminifera*, not detached like those of more modern type, but that they lived and grew in a peculiar mode over wide areas in the sea bottom, in a manner somewhat analogous to the mode of growth of a bank of corals. The chambers (as shown in the diagrams used) are unsymmetrical, and while growing spread irregularly, and they are enclosed above and below by a layer having a finely tubular structure similar to that of the shell of the nummulite and other allied forms. Between these layers the sarcode-body was enclosed, and between the irregular chambers there frequently lies an inter-skeleton, penetrated by numerous branching tubes, and by an occasional larger tube, called by Dr. Carpenter the stolon. The chambers that contained the sarcode-body and the tubes now consist of serpentine, and the inter-skeleton of carbonate of lime; and on an acid being applied the silicious casts of the tubes are found so arranged that Dr. Dawson and Dr. Carpenter had no doubt as to the organic nature of the specimens, which were examined by them with the microscope most carefully. Better authority it is impossible to have.

Having visited the district with Sir Wm. Logan, I think I may safely say that the chief part of all the bands of limestone is so crystalline (from metamorphic action) that it is hopeless to expect to find fossils in them; but that part of the band No. 2, in which they have heretofore been observed, attains a thickness of about 200 feet, and doubtless *Eozoon* or other traces of organic remains may yet be found elsewhere. It is by a lucky accident, so to speak, in metamorphic action, that they have been preserved where we now find them, and, said the speaker, "I for one firmly believe not only that all these Laurentian deposits were of marine origin, but also that the original matter of limestones of such vast thickness, and that once spread so widely over that old sea bottom, must have been chiefly formed by the growth and decay of organic bodies."

Mr. Ramsay then showed the importance of these discoveries in relation to *geological time*.

First he spoke of metamorphism having, according to the best hypothesis, been produced by heated alkaline waters in rocks deeply buried beneath vast accumulations of strata, since removed by denudation.

Before the commencement of the Silurian epoch such metamorphic actions had already taken place three times: first, in the lower Laurentian rocks; secondly, in the upper Laurentian rocks; and thirdly, in the Huronian series, and each set of strata had evidently been subjected to prodigious waste and denudation, before the com-



mencement of the formation that now succeeds it in the American series.

But secondly, geological time is not to be measured merely by the formations now existing, for the unconformities indicate gaps, or periods of time, stratigraphically unrepresented, which were probably far longer in duration than the time occupied in the deposition of the formations that remain.\*

Again, an instructive moral may be drawn from a consideration of the subject with regard to the style of reasoning that has often been too prevalent with respect to the discovery of the oldest zones of life of various kinds. For example, for many years no one doubted that the lower tertiary or eocene beds contained the oldest relics of mammalian life, and a great outcry of disbelief was raised when they were discovered in the secondary rocks in the Stonesfield slate of the lower Oolite. Since then the *Microlestes* has been found in the new red series, and there for the time it rests. The same kind of astonishment prevailed as reptile bones were successively discovered down through the Lias into the Trias, and from these into the Palæozoic formations of permian, carboniferous, and old red sandstone age. And when we consider the history of the mollusca, as recorded by distinguished geologists, the same hankering after finality has constantly cropped out. The "primary formations," it was said, contained no fossils, for they were formed before the creation of life began: till late in last century Hutton dispelled the illusion by proving the presence of fossil shells in so-called "primary clay-slates." For some time the Llandeilo flags of Sir Roderick Murchison were regarded as the oldest fossiliferous rocks, till on the discovery of the still older lingula flags and their equivalents in Bohemia, they were fondly named the *primordial zone*. "Here at last is a resting place: we can hope for nothing older than the lingulæ and trilobites of this great original 'primordial zone;' but soon Mr. Salter found annelids, and, as he thinks, trilobites on a horizon lower still, and the beginning was again thrown farther back into time; and no one dared to dream of traces of life yet older being found in gneiss, for if they even ever existed there, which is improbable, they must have been all obliterated by metamorphic action. Suddenly Sir W. Logan makes a great leap, thousands of fathoms deeper than any formation previously known to contain the relics of life, and from the limestones there extracts the Eozoon, from rocks so immeasurably older than the oldest Silurian and Cambrian strata, that no power of imagination can feebly realise, even in a geological sense, the great gaps that lie between them; and though we may feebly attempt to estimate the latest lapses of geological time, we can no more hope to fathom these Laurentian depths than we can hope to measure the distance of the most unresolvable of the unresolved nebulae, merely because we are able to estimate our distance from the sun."

## NOTICES OF PATENTS.

1913. *Manufacture of Green Colouring Matters to be Used in Dyeing and Printing.* H. CARTER, Camberwell New Road. Dated August 1, 1864.

1949. *Producing Colour from Aniline.* A. H. A. PILUGHAUPT, Manchester. Dated August 4, 1864. (Not proceeded with.)

IN the first of these patents the object of the inventor is to produce a green colouring matter by the action of copper or iron salts, or mixtures of these, upon suitable compounds of aniline, toluidine, or homologous bases. The product thus obtained may be employed alone for

dyeing or printing, or the tint may be modified by admixture of soluble blue or purple colour.

According to the second specification, it is proposed to effect the conversion of neutral aniline salts (of commercial quality, and, therefore, containing toluidine) into magenta dye or other compounds of rosaniline by the action of atmospheric oxygen at an elevated temperature. The inventor employs a basic compound in admixture with the aniline salt for the purpose of absorbing the free acid commonly liberated during the conversion of aniline into rosaniline; and he states that his mode of production possesses the advantage of economy, inasmuch as none of the aniline distils over, and a subsequent treatment is thereby avoided.

1937. *Making Non-Inflammable Plain and Twilled Dyed Cotton Fabrics, &c.* B. O'CONNER, Manchester. Dated August 4, 1864.

1957. *Rendering Uninflammable Cotton, Silk, &c.* E. HOTTIN, Paris. Dated August 6, 1864. (Not proceeded with.)

FOR the purpose of rendering cotton and other textile fabrics uninflammable Mr. O'Conner passes the goods through a solution of one part of chloride of magnesium in four parts of water, or immerses them in the liquid until they have become thoroughly saturated. The pieces are then removed, dried, and finished in the usual manner. The patentee claims the employment of other salts of magnesium for the same purpose, and lays stress upon the use of a small proportion of the bromide, not exceeding ten per cent., in conjunction with the chloride.

M. Hottin effects the same purpose by the old method of treatment with an aqueous solution of phosphate of ammonia, and gives directions for its preparation by adding ammonia to aqueous biphosphate of calcium, and digesting the filtered solution with precipitated silica. The goods are dressed in the usual manner, with starch, gum, or dextrine.

The deliquescent character of the salts recommended to be used in the above specifications must be very detrimental to their employment; and if, on the other hand, a crystallisable salt be selected, such as the sulphate of magnesia included in the claim of Mr. O'Conner, it is well known that a certain degree of rottenness by disintegration of the fibre is the result.

1941. *Coatings for the Prevention of the Fouling of the Bottoms of Iron and other Ships.* F. CRUICKSHANK, Edinburgh. Dated August 4, 1864.

1962. *Compositions for Preventing the Bottoms of Iron Ships from Fouling or Corroding.* C. BARTLEY, Blackheath. Dated August 6, 1864.

THESE patents both refer to the employment of mercurial preparations, with or without white lead paint, for the purpose of preventing the attachment of sea plants and animals, and overcoming the corrosion of ships' bottoms. The first specially claims the use of red oxide of mercury, white precipitate of the British Pharmacopœia, or any one of the various combinations of corrosive sublimate with oxide of mercury to which the name of "oxychloride of mercury" may be applied. These several materials are rendered applicable for the purpose by being incorporated with resinous or oleaginous media, and are then laid on the iron, or other metallic surfaces, like paints.

The second specification describes the use of corrosive sublimate conjointly with white lead. The mercury salt is dissolved in methylated spirit, and incorporated with the lead paint in the following proportions:—

White lead paint	.	.	.	1 cwt.
Corrosive sublimate	.	.	.	6 lbs.
Powdered gum arabic	.	.	.	6 "
Castor oil	.	.	.	6 "

\* See the Presidential Anniversary Addresses to the Geological Society for the years 1863 and 1864, by Professor A. C. Ramsay.



It is recommended to apply this material as a second coating upon one of pure white lead paint, and then to lay on a third coating similar to the second, but with the addition of three pounds of verdigris and two pounds more of corrosive sublimate (*i.e.*, eight pounds instead of six), mixed with one gallon of whale oil and the other materials already indicated.

#### GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. VAUGHAN, PATENT AGENT, 54, Chancery Lane, W.C.

1515. H. Allman, Ampthill Square, Middlesex, "Certain improvements in the means employed for the prevention of the ignition of matter capable of ignition or combustion."—Petition recorded June 2, 1865.

1535. P. Coombes, Liverpool, "An improved apparatus for separating the whey from the curd in the manufacture of cheese."—June 5, 1865.

1553. J. Howarth, M.D., Andover, Mass., U.S.A., "An improved method for distilling coal, shale, and other carbonaceous substances."—A communication from J. Howarth, Salem, U.S.A.

1554. A. C. Henderson, Charing Cross, "Improvements in tanning hides, and in apparatus connected therewith."—A communication from E. S. Beaux and E. Pannifex, Paris.

1559. W. Sim and A. Barff, Glasgow, N.B., "An improved method of generating heat, and in the apparatus or means for effecting the same."

1560. J. Ferguson and R. Miller, Glasgow, N.B., "Improvements in the manufacture of steel."—June 7, 1865.

#### NOTICES TO PROCEED.

366. J. C. C. Halkett, Cramond Iron Works, County of Mid Lothian, N.B., "Improvements in protecting wooden surfaces from the fouling and injury to which they are ordinarily liable in sea water."

371. J. Dale, Manchester, "Improvements in the production of substances to be used in place of the pigment usually termed satin white."—Petitions recorded Feb. 9, 1865.

388. J. Hall, Nottingham, "The manufacture or production of oil for the use of machinery, or for other similar purposes."—Feb. 11, 1865.

403. J. A. Pastorelly, Rue Curiol, Marseilles, "Improvements in extracting turpentine and tar from resinous wood."

408. E. J. C. Welch, Harrow, Middlesex, "Improved apparatus for supplying, with a constant and regular pressure, air to burners for consuming or burning hydrocarbons for illuminating purposes."—Feb. 13, 1865.

419. E. H. Newby, Cheapside, "Improvements in the manufacture of cast and wrought iron."—A communication from A. L. Fleury, New York, U.S.A.—Feb. 14, 1865.

449. F. A. Laurent, J. Casthelaz, and N. Basset, Rue St. Croix de la Bretonnerie, Paris, "Improvements in the manufacture of oxalic acid."—Feb. 16, 1865.

470. W. Robinson, Watling Street, London, "Improvements in the manufacture of iron and in articles made thereof."—Feb. 18, 1865.

478. J. Cliff, Wortley, near Leeds, "An improvement in the utilisation of the waste gases of blast furnaces."—Feb. 20, 1865.

666. J. Cliff, Wortley, near Leeds, "An improvement in the construction of hot-air stoves for blast furnaces."—March 9, 1865.

945. J. R. Wigham, Monkstown, County Dublin, "Improvements in the means and apparatus employed for illuminating lighthouses."—April 4, 1865.

#### CORRESPONDENCE.

##### *On the Red Hematites of Waldeck.*

To the Editor of the CHEMICAL NEWS.

SIR,—I have been lately exploring the iron, copper, and lead districts of the principality of Waldeck, and wish to call your attention to some peculiarity presented by the red hematites of that district. Red hematite is very abundant in Waldeck and Hesse, though not often near the surface; it is always mixed with a notable proportion of magnetic oxide of iron, and in some places passes into a peculiar crystalline mineral, containing upwards of 20 per cent. of magnetic oxide, though still retaining the crystalline form of peroxide of iron. Some of these ores have been already analysed in my laboratory in London, and on my return to England I will, with your permission, forward to the CHEMICAL NEWS the details of their composition.—I am, &c. T. L. PHIPSON, Ph.D., F.C.S., &c.

Frankfurt, A. M., June 20.

#### MISCELLANEOUS.

**Death of Professor Reveil.**—Dr. Réveil was one of the most promising scientific chemists of Paris, attached as assistant professor both to the Faculty of Medicine and the School of Pharmacy. He died suddenly at a nursery garden in Versailles, where he was ordering flowers for a family party, at the age of 44. The deceased may be said to have died of overwork, as the public and courts of law placed the most implicit confidence in him as an analytical chemist. Dr. Réveil obtained all his appointments by competition, and was an indefatigable labourer in the branch of science he had chosen. He published many works, and quite lately a translation of Mr. Piesse's book on perfumes.—*Lancet*.

**Important Invention.**—The *Western Morning News* states that Mr. Gale, electrician, of Plymouth, has discovered a process by which powder can be rendered non-explosive, and its properties restored when required. The process is simple and effective, and cannot injure the powder. The cost is very small, and it has the advantage of being readily applied. In five minutes a barrel of powder can be made non-explosive, and in another five minutes it can be restored to its original condition. The invention will solve the difficulty which has been felt as to the storage of powder in time of peace, and in war it will avert the danger which now arises from the necessity of fighting in the neighbourhood of an explosive material.

**Estimation of Carbon in Cast-iron.**—Weyl connects the iron with the positive pole of a Bunsen's battery, and immerses it in hydrochloric acid with a platinum plate for negative pole. This method is recommended by Fresenius, and has been employed by Kinmann for Bessemer steel, in which he found 0.65 per cent. of carbon.—*Chem. Cent. Blatt*, 1865, p. 368.

#### ANSWERS TO CORRESPONDENTS.

J. R.—1. Yes. 2. We think not.

P. Scott.—It should be acid.

F.R.S.—The answer to your query would be too long for insertion here; we have therefore left it for you at the CHEMICAL NEWS Office, addressed to you in your private name.

A Tyro.—We are always happy to be of every possible use to our subscribers, but we really cannot be expected to answer questions the solutions to which may be found in every chemical handbook.

Received with Thanks.—R. V. Tuson; Geo. Jones, F.C.S.; C. M. Warren.

Books Received.—"On the Composition of the Atmosphere," by Dr. R. Angus Smith, F.R.S. "Braithwaite's Retrospect of Medicine," January to June, 1865. "The Sewage Committee of 1864," by Thos. Spencer, F.C.S. (pamphlet).



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